Installation and Configuration Guide

HP StorageWorks HSG80 ACS Solution Software V8.8

for Linux X86

Product Version: 8.8-1

First Edition (March 2005)

Part Number: AA–RV1LA–TE

This guide provides installation and configuration instructions and reference material for operation of the HSG80 ACS Solution Software V8.8-1 for Linux X86.

HSG80 ACS Solution Software V8.8 for Linux X86 Installation and Configuration Guide
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about this guide

This installation guide for HSG80 ACS Solution Software V8.8-1 for Linux X86 provides information to help you:

- Plan the storage array subsystem.
- Install and configure the storage array subsystem on individual operating system platforms.

“About this Guide” topics include:

This book does not contain information about the operating environments to which the controller may be connected, nor does it contain detailed information about subsystem enclosures or their components. See the documentation that accompanied these peripherals for information about them.

Overview

This section covers the following topics:

Intended Audience

This book is intended for use by systems administrators and systems technicians who are experienced with the following:

- Storage
- Networking

Related Documentation

In addition to this guide, HP provides corresponding information:

- ACS V8.8-1 controller documentation
- *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide*, EK-G80CL-RA. C01
- *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Maintenance and Service Guide*, EK-G80MS-SA. C01
- *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Troubleshooting Guide*, EK-G80TS-SA. C01
- SWCC v2.5 documentation (Client software delivered in solutions kits)
- *HP StorageWorks Command Console User Guide*, AA-RV1UA-TE
- *HP StorageWorks Command Console Release Notes*, AV-RV1TA-TE
- *HP StorageWorks Command Console Help Files*, AA-RS20A-TE and AA-RS21A-TE
- Host-specific documentation (SWCC Agent and HBA software delivered in solutions kits)
- Solution Software Release Notes (platform-specific)

Solution software host support includes the following platforms:

- IBM AIX
- HP-UX
- Linux (Red Hat x86, SuSE x86)
- Novell NetWare
- Open VMS
- Sun Solaris
- Tru64 UNIX
- Windows NT/2000/Windows Server 2003 (32-bit)

Additional support required by HSG80 ACS Solution Software V8.8-1, but delivered through external programs, includes the following:

- Heterogeneous “rules based” SAN configurations
- Host-Bus Adapter (HBA) products
- Applicable Storage Utility Management Suite (SUMS) components
- Vendor-specific switch products
- Secure Path products (Windows, NetWare, Sun, AIX, HP-UX)
- Data Replication Manager (DRM) under ACS 8.8-1
- Enterprise Volume Manager (EVM) under ACS 8.8-1
- Enterprise Backup Solution (EBS)
- Additional ACS variants (W, R)

Chapter Content Summary

Table 1 below summarizes the content of the chapters.

Table 1: Summary of chapter contents

Chapters	Descriptions
1. Planning a Subsystem	This chapter focuses on technical terms and knowledge needed to plan and implement storage array subsystems.
2. Planning Storage Configurations	Plan the storage configuration of your subsystem, using individual disk drives (JBOD), storageset types (mirrorsets, stripesets, and so on), and/or partitioned drives. This chapter describes addressing conventions, configuration rules, creating storage profiles, and creating storage maps.
3. Preparing the Host System	How to prepare your Linux host computer to accommodate the HSG80 controller storage subsystem.
4. Installing and Configuring HSG Agent	The Agent for HSG for a specific operating system polls the storage.
5. FC Configuration Procedures	How to configure a subsystem that uses Fibre Channel (FC) fabric topology. In fabric topology, the controller connects to its hosts through switches.
6. Using CLI for Configuration	How-to example of configuring a storage subsystem using the Command Line Interpreter (CLI).

Table 1: Summary of chapter contents (Continued)

Chapters	Descriptions
7. Backing Up, Cloning, and Moving Data	Description of common procedures that are not mentioned elsewhere in this guide. ■ Backing Up Subsystem Configuration ■ Cloning Data for Backup ■ Moving Storagesets
Appendix A. Subsystem Profile Templates	This appendix contains storageset profiles to copy and use to create your system profiles. It also contains an enclosure template to use to help keep track of the location of devices and storagesets in your shelves. Four (4) templates are needed for the subsystem.
Appendix B. Installing, Configuring, and Removing the Client	The Client monitors and manages a storage subsystem. The following information is included in this appendix: ■ Why Install the Client? ■ Before You Install the Client ■ Installing the Client ■ Installing the Integration Patch ■ Troubleshooting Client Installation ■ Adding Storage Subsystem and its Host to the Navigation Tree ■ Removing the Command Console Client ■ Where to Find Additional Information

Conventions

Conventions consist of the following:

- "Document Conventions"
- "Symbols in Text"
- "Symbols on Equipment"

Document Conventions

This document follows the conventions in Table 2.

Table 2: Document conventions

Convention	Element
Blue text: Figure 1	Cross-reference links
Bold	Menu items, buttons, and key, tab, and box names
Italics	Text emphasis and document titles in body text
`Monospace font`	User input, commands, code, file and directory names, and system responses (output and messages)
`Monospace, italic font`	Command-line and code variables
Blue underlined sans serif font text (http://www.hp.com)	Web site addresses

Symbols in Text

The following symbols may be found in the text of this guide. They have the following meanings:

WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or death.

Caution: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

Tip: Text in a tip provides additional help to readers by providing nonessential or optional techniques, procedures, or shortcuts.

Note: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Symbols on Equipment

The following equipment symbols may be found on hardware for which this guide pertains. They have the following meanings:

Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

WARNING: To reduce the risk of personal injury from electrical shock hazards, do not open this enclosure.

Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

WARNING: To reduce the risk of personal injury from a hot component, allow the surface to cool before touching.

Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

WARNING: To reduce the risk of personal injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.

Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

Rack Stability

Rack stability protects personnel and equipment.

WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
- The full weight of the rack rests on the leveling jacks.
- In single rack installations, the stabilizing feet are attached to the rack.
- In multiple rack installations, the racks are coupled.
- Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.

Getting Help

If you still have a question after reading this guide, contact an HP authorized service provider or access our web site http://www.hp.com.

HP Technical Support

Telephone numbers for worldwide technical support are listed on the following HP web site http://www.hp.com/support/. From this web site, select the country of origin.

Note: For continuous quality improvement, calls may be recorded or monitored.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

HP Storage Web Site

The HP web site has the latest information on this product, as well as the latest drivers. Access the storage web site at http://www.hp.com/country/us/eng/prodserv/storage.html. From this web site, select the appropriate product or solution.

HP Authorized Reseller

For the name of your nearest HP authorized reseller:

- In the United States, call 1-800-345-1518
- In Canada, call 1-800-263-5868
- Elsewhere, see the HP web site for locations and telephone numbers http://www.hp.com.

Configuration Flowchart

A three-part flowchart (Figures 1-3) is shown on the following pages. Refer to these charts while installing and configuring a new storage subsystem. All references in the flowcharts pertain to pages in this guide, unless otherwise indicated.

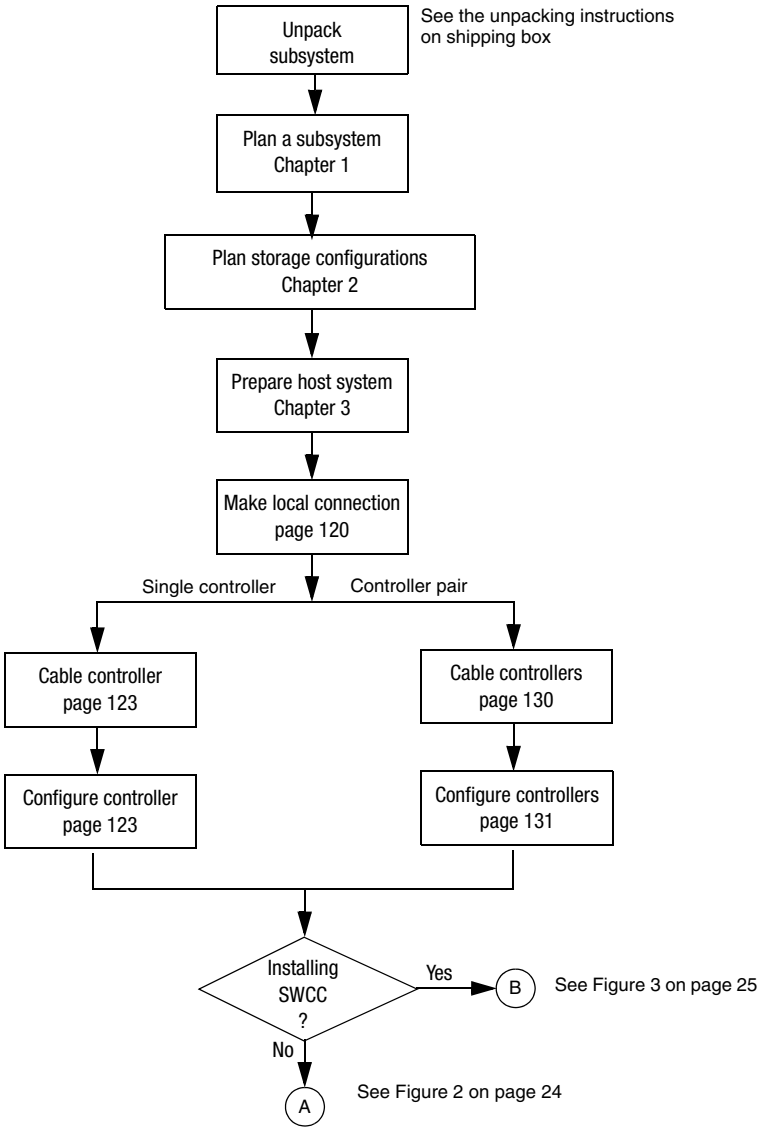


Figure 1: General configuration flowchart (panel 1)

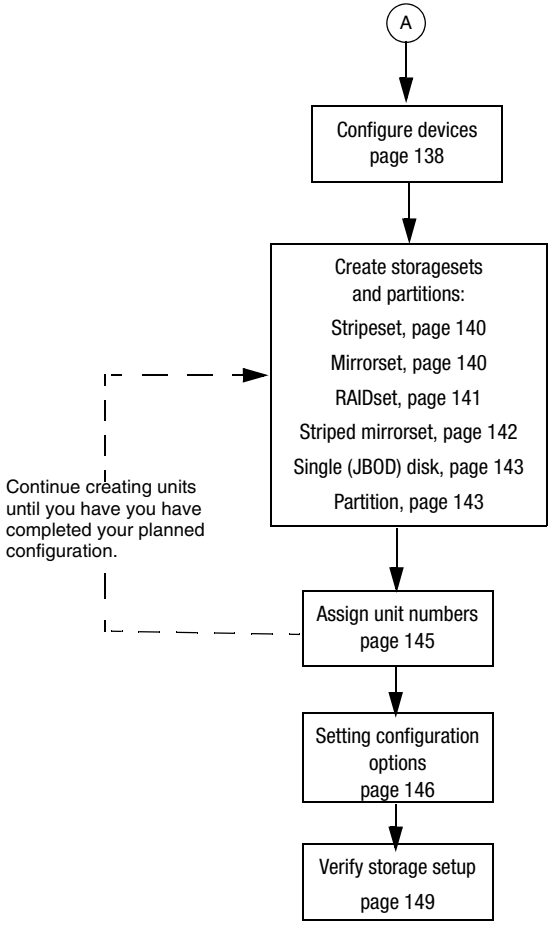


Figure 2: General configuration flowchart (panel 2)

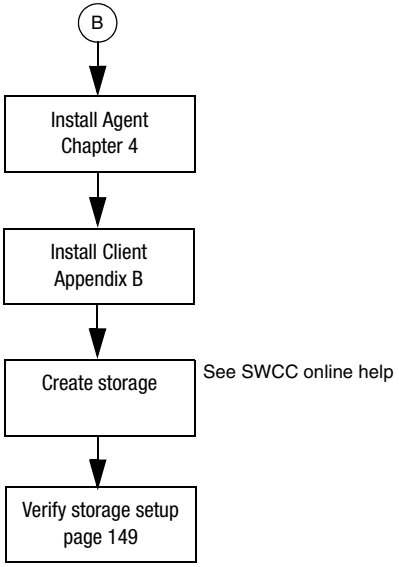


Figure 3: Configuring storage with SWCC flowchart (panel 3)

Planning a Subsystem

1

This chapter provides information that helps you plan how to configure the storage array subsystem. This chapter focuses on the technical terms and knowledge needed to plan and implement storage subsystems.

Note: This chapter frequently references the command line interface (CLI). For the complete syntax and descriptions of the CLI commands, see the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide*.

The following information is included in this chapter:

Note: DILX should be run for ten minutes on all units to delete the 8 MB EISA partition. Refer to *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide* for details.

Refer to Chapter 2 when planning the types of storage containers you need. Storage containers are individual disk drives (JBOD), storageset types (mirrorsets, stripesets, and so on), and/or partitioned drives.

Defining Subsystems

This section describes the terms *this controller* and *other controller.* It also presents graphics of the Model 2200 and BA370 enclosures.

Note: The HSG80 controller uses the BA370 or Model 2200 enclosure.

Controller Designations A and B

The terms A, B, "this controller," and "other controller," respectively are used to distinguish one controller from another in a two-controller (also called dual-redundant) subsystem.

Controllers and cache modules are designated either A or B depending on their location in the enclosure, as shown in Figure 4 for the Model 2200 enclosure and in Figure 5 for the BA370 enclosure.

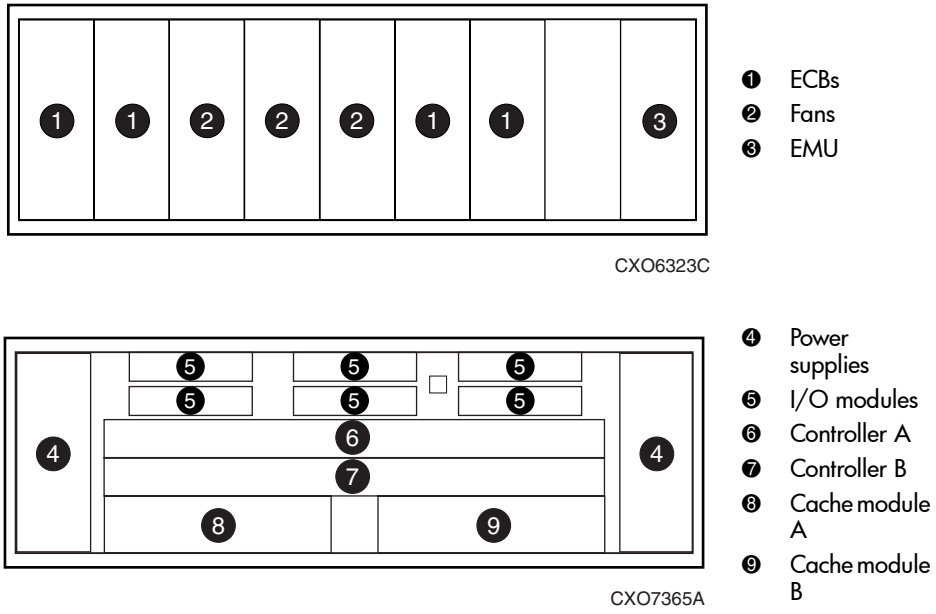


Figure 4: Location of controllers and cache modules in a Model 2200 enclosure

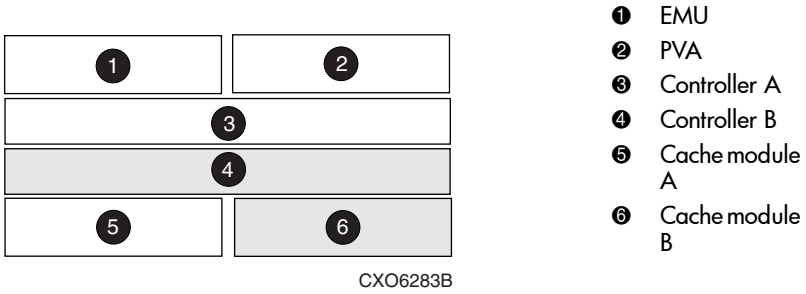


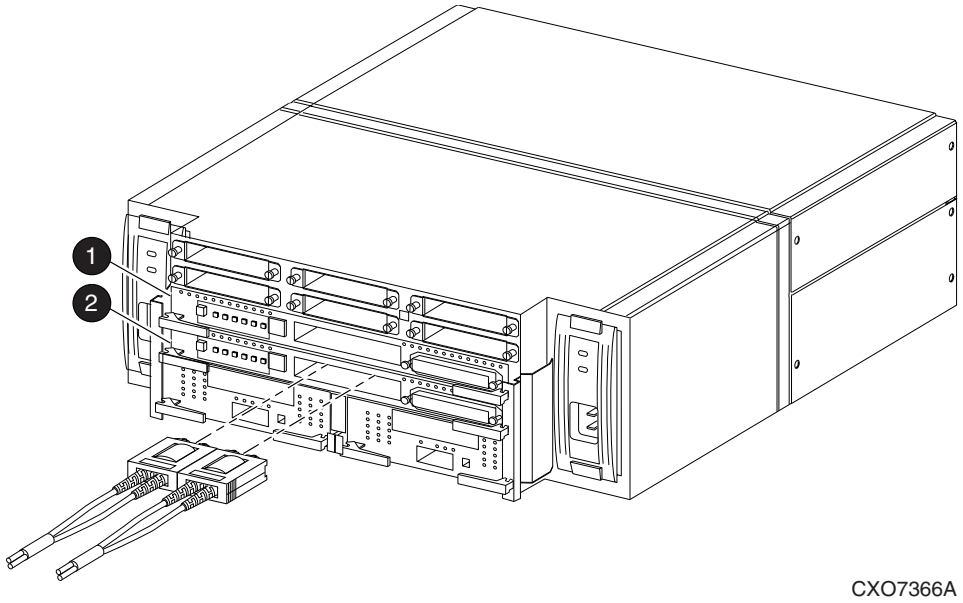
Figure 5: Location of controllers and cache modules in a BA370 enclosure

Controller Designations "This Controller" and "Other Controller"

Some CLI commands use the terms "this" and "other" to identify one controller or the other in a dual-redundant pair. These designations are a shortened form of "this controller" and "other controller." These terms are defined as follows:

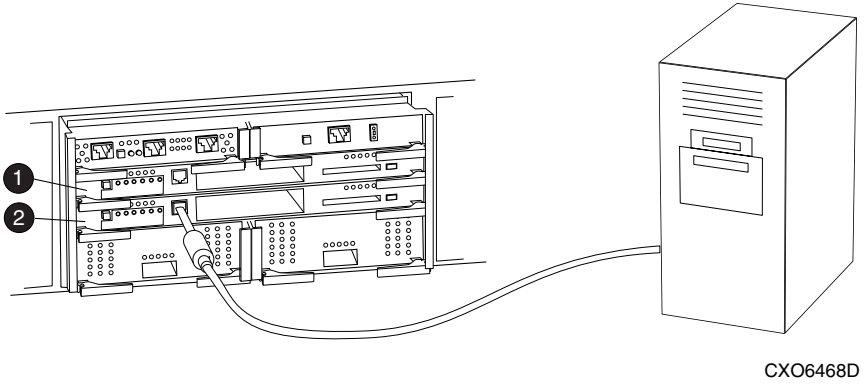
- "**This controller**"—the controller that is the focus of the CLI session. "This controller" is the controller to which the maintenance terminal is attached and through which the CLI commands are being entered. "This controller" can be abbreviated to "this" in CLI commands.
- "**Other controller**"—the controller that is not the focus of the CLI session and through which CLI commands are not being entered. "Other controller" can be abbreviated to "other" in CLI commands.

Figure 6 shows the relationship between "this controller" and "other controller" in a Model 2200 enclosure. Figure 7 shows the same relationship in a BA370 enclosure.



❶ This controller ❷ Other controller

Figure 6: "This controller" and "other controller" for the Model 2200 enclosure



❶ Other controller ❷ This controller

Figure 7: "This controller" and "other controller" for the BA370 enclosure

What is Failover Mode?

Failover is a way to keep the storage array available to the host if one of the controllers becomes unresponsive. A controller can become unresponsive because of a controller hardware failure. Failover keeps the storage array available to the hosts by allowing the surviving controller to take over total control of the subsystem.

Transparent Failover Mode

Transparent failover mode has the following characteristics:

- Hosts do not know failover has taken place.
- Units are divided between host ports 1 and 2.

A unit or storageset is a physical or virtual device of the subsystem. It is typically assigned a logical unit number (LUN) and is managed by the HSG80 controller and presented to a server through the Fibre Channel bus and the server's host bus adapter. Disks that are set up as independent disks (JBODs) or RAIDsets are referred to as storagesets.

In transparent failover mode, host port 1 of controller A and host port 1 of controller B must be on the same Fibre Channel link. Host port 2 of controller A and host port 2 of controller B must also be on the same Fibre Channel link. Depending on operating system restrictions and requirements, the port 1 link and the port 2 link can be separate links, or they can be the same link.

At any time, host port 1 is active on only one controller, and host port 2 is active on only one controller. The other ports are in standby mode. In normal operation, both host port 1 on controller A and host port 2 on controller B are active. A representative configuration is shown in Figure 8. The active and standby ports share port identity, enabling the standby port to take over for the active one. If one controller fails, its companion controller (known as the surviving controller) takes control by making both its host ports active, as shown in Figure 9.

Units are divided between the host ports:

- Units 0–99 are on host port 1 of both controllers (but accessible only through the active port).
- Units 100–199 are on host port 2 of both controllers (but accessible only through the active port).

Transparent failover only compensates for a controller failure, and not for failures of either the Fibre Channel link or host Fibre Channel adapters.

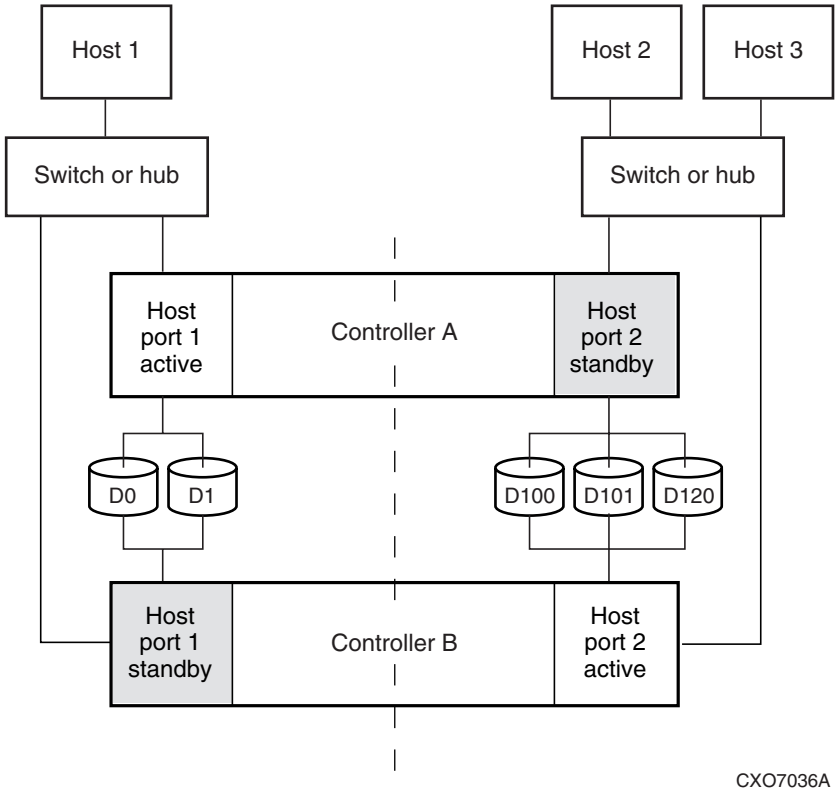


Figure 8: Transparent failover—normal operation

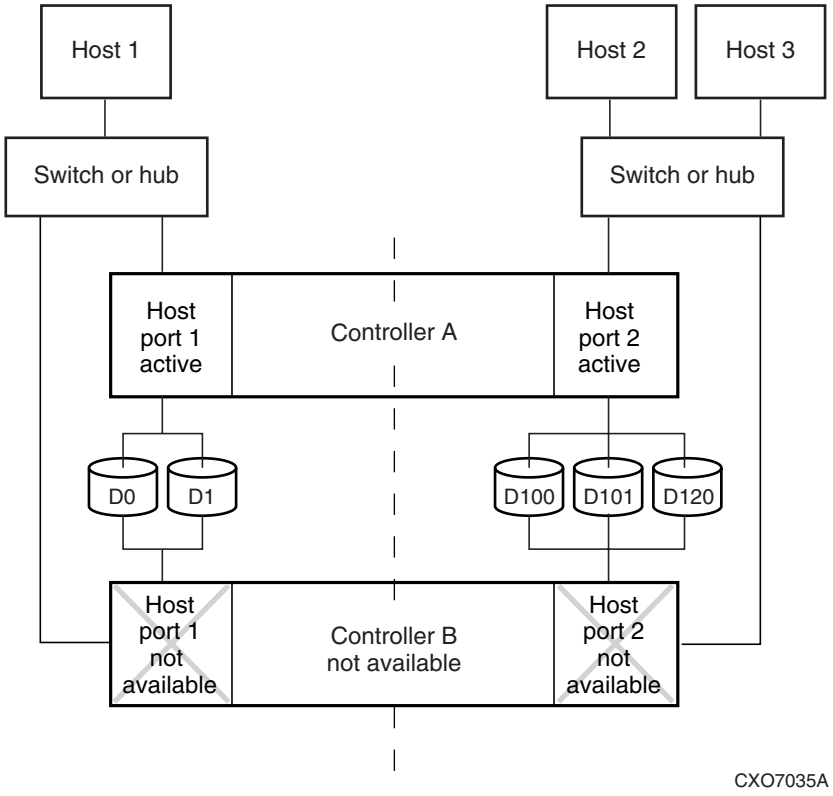


Figure 9: Transparent failover—after failover from Controller B to Controller A

Selecting a Cache Mode

The cache module supports read, read-ahead, write-through, and write-back caching techniques. The cache technique is selected separately for each unit. For example, you can enable only read and write-through caching for some units while enabling only write-back caching for other units.

Read Caching

When the controller receives a read request from the host, it reads the data from the disk drives, delivers it to the host, and stores the data in its cache module. Subsequent reads for the same data takes the data from cache rather than accessing the data from the disks. This process is called read caching.

Read caching can improve response time to many of the host's read requests. By default, read caching is enabled for all units.

Read-Ahead Caching

During read-ahead caching, the controller anticipates subsequent read requests and begins to prefetch the next blocks of data from the disks as it sends the requested read data to the host. This is a parallel action. The controller notifies the host of the read completion, and subsequent sequential read requests are satisfied from the cache memory. By default, read-ahead caching is enabled for all units.

Write-Back Caching

Write-back caching improves the subsystem's response time to write requests by allowing the controller to declare the write operation complete as soon as the data reaches cache memory. The controller performs the slower operation of writing the data to the disk drives at a later time.

By default, write-back caching is enabled for all units, but only if there is a backup power source for the cache modules (either batteries or an uninterruptible power supply).

Write-Through Caching

Write-through caching is enabled when write-back caching is disabled. When the controller receives a write request from the host, it places the data in its cache module, writes the data to the disk drives, then notifies the host when the write operation is complete. This process is called write-through caching because the data actually passes through—and is stored in—the cache memory on its way to the disk drives.

Enabling Mirrored Caching

In mirrored caching, half of each controller's cache mirrors the companion controller's cache, as shown in Figure 10.

The total memory available for cached data is reduced by half, but the level of protection is greater.

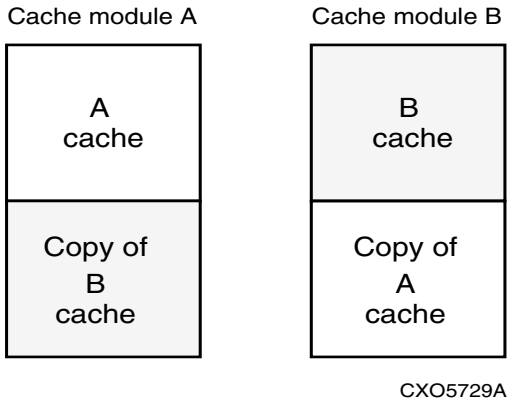


Figure 10: Mirrored caching

Before enabling mirrored caching, make sure the following conditions are met:

- Both controllers support the same size cache.
- Diagnostics indicate that both caches are good.
- No unit errors are outstanding, for example, lost data or data that cannot be written to devices.
- Both controllers are started and configured in failover mode.

What is the Command Console LUN?

StorageWorks Command Console (SWCC) software communicates with the HSG80 controllers through an existing storage unit, or logical unit number (LUN). The dedicated LUN that SWCC uses is called the Command Console LUN (CCL). The CCL serves as the communication device for the HS-Series Agent and identifies itself to the host by a unique identification string. By default, a CCL device is enabled within the HSG80 controller on host port 1. The HSG80 uses SCSI-3 with your platform.

Note: Linux requires the controllers be set to SCSI-3 mode.

The CCL does the following:

- Allows the RAID Array to be recognized by the host as soon as it is attached to the SCSI bus and configured into the operating system.
- Serves as a communications device for the HS-Series Agent. The CCL identifies itself to the host by a unique identification string.

In dual-redundant controller configurations, the commands described in the following sections alter the setting of the CCL on both controllers. The CCL is enabled only on host port 1.

Determining the Address of the CCL

CCL is enabled by default. Its address can be determined by entering the following CLI command:

```
HSG80 > SHOW THIS_CONTROLLER
```

Enabling/Disabling the CCL in SCSI-2 Mode

Enabling the CCL

To enable the CCL, enter the following CLI command:

```
HSG80 > SET THIS_CONTROLLER COMMAND_CONSOLE_LUN
```

Disabling the CCL

To disable the CCL, enter the following CLI command:

```
HSG80 > SET THIS_CONTROLLER NOCOMMAND_CONSOLE_LUN
```

To see the state of the CCL, use the SHOW THIS CONTROLLER/ OTHER CONTROLLER command. Because the CCL is not an actual LUN, the SHOW UNITS command does not display the CCL location.

Enabling/Disabling CCL in SCSI-3 Mode

The CCL is enabled all the time. There is no option to enable/disable.

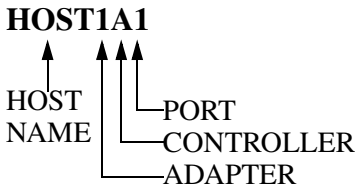
Determining Connections

The term “connection” applies to every path between a Fibre Channel adapter in a host computer and an active host port on a controller.

Note: In ACS V8.8-1, the maximum number of supported connections is 96.

Naming Connections

It is highly recommended that you assign names to connections that have meaning in the context of your particular configuration. One system that works well is to name each connection after its host, its adapter, its controller, and its controller host port, as follows:



Examples:

A connection from the first adapter in the host named RED that goes to port 1 of controller A would be called RED1A1.

A connection from the third adapter in host GREEN that goes to port 2 of controller B would be called GREEN3B2.

Note: Connection names can have a maximum of 9 characters.

Numbers of Connections

The number of connections resulting from cabling one adapter into a switch or hub depends on failover mode and how many links the configuration has:

- If a controller pair is in transparent failover mode and the port 1 link is separate from the port 2 link (that is, ports 1 of both controllers are on one loop or fabric, and port 2 of both controllers are on another), each adapter has one connection, as shown in Figure 11.
- If a controller pair is in transparent failover mode and port 1 and port 2 are on the same link (that is, all ports are on the same loop or fabric), each adapter has two connections, as shown in Figure 12.

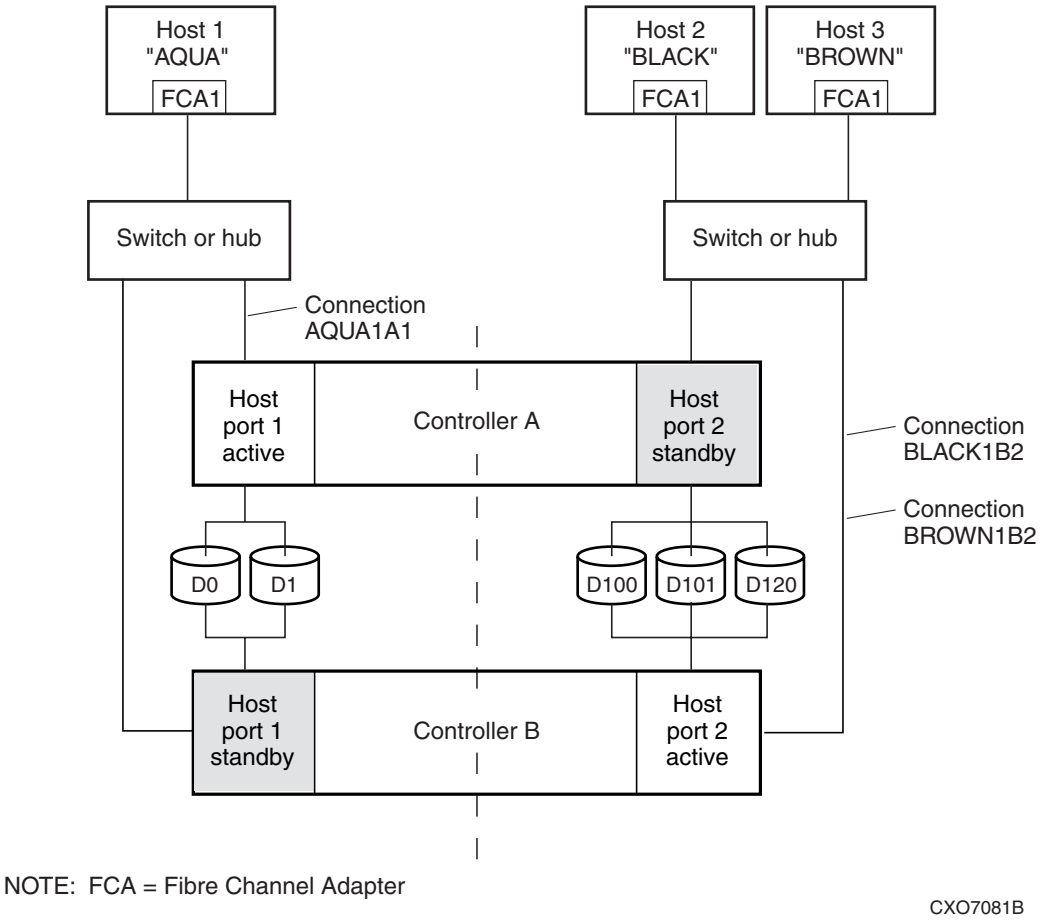


Figure 11: Connections in separate-link, transparent failover mode configurations

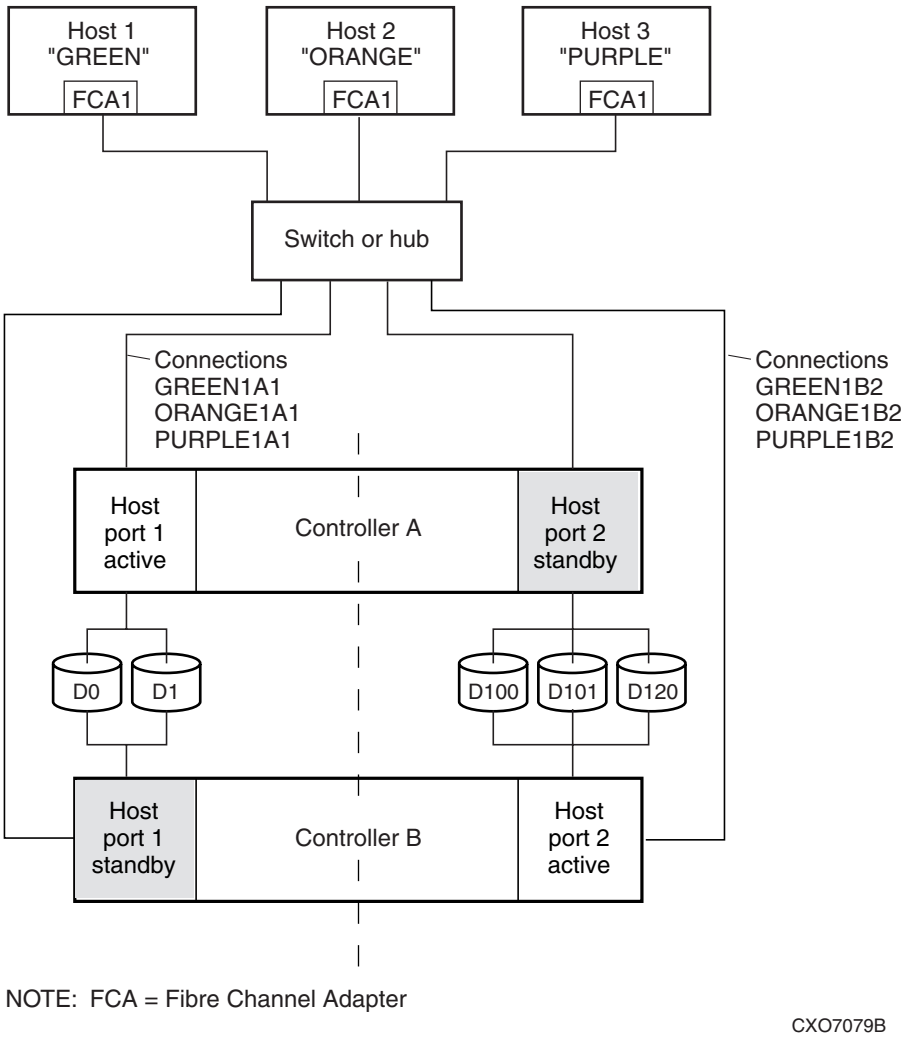


Figure 12: Connections in single-link, transparent failover mode configurations

Assigning Unit Numbers

The controller keeps track of the unit with the unit number. The unit number can be from 0–199 prefixed by a D, which stands for disk drive. A unit can be presented as different LUNs to different connections. The interaction of a unit and a connection is determined by several factors:

- Failover mode of the controller pair
- The ENABLE_ACCESS_PATH and PREFERRED_PATH switches in the ADD UNIT (or SET *unit*) commands
- The UNIT_OFFSET switch in the ADD CONNECTIONS (or SET *connections*) commands
- The controller port to which the connection is attached
- The SCSI_VERSION switch of the SET THIS_CONTROLLER/OTHER_CONTROLLER command

The considerations for assigning unit numbers are discussed in the following sections.

Matching Units to Host Connections in Transparent Failover Mode

In transparent failover mode, the ADD UNIT command creates a unit for host connection to access and assigns it to either port 1 or port 2 of both controllers.

Unit numbers are assigned to ports as follows:

- 0–99 are assigned to host port 1 of both controllers.
- 100–199 are assigned to host port 2 of both controllers.

For example, unit D2 is on port 1, and unit D102 is available through port 2.

The LUN number that a host connection assigns to a unit is a function of the UNIT_OFFSET switch of the ADD (or SET) CONNECTIONS command. The relationship of offset, LUN number, and unit number is shown in the following equation:

LUN number = unit number – offset

Where...

— LUN number is relative to the host (what the host sees the unit as)

— Unit number is relative to the controller (what the controller sees the unit as)

If no value is specified for offset, then connections on port 1 have a default offset of 0 and connections on port 2 have a default offset of 100.

For example, if all host connections use the default offset values, unit D2 is presented to a port 1 host connection as LUN 2 (unit number of 2 minus offset of 0). Unit D102 is presented to a port 2 host connection as LUN 2 (unit number of D102 minus offset of 100).

Figure 13 shows how units are presented as different LUNs, depending on the offset of the host. In this illustration, host connection 1 and host connection 2 would need to be on host port 1; host connection 3 would need to be on host port 2.

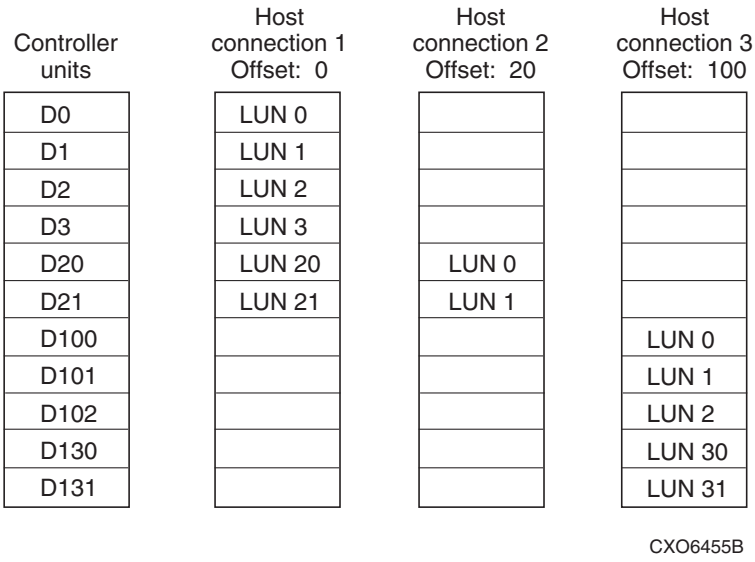


Figure 13: LUN presentation to hosts, as determined by offset

Offsets other than the default values can be specified. For example, unit D17 would be visible to a host connection on port 1 that had an offset of 10 as LUN 7 (unit number of 17 minus offset of 10). The unit would not be visible to a host connection with a unit offset of 18 or greater, because that offset is not within the unit's range (unit number of 17 minus offset of 18 is a negative number).

Similarly, unit D127 would be visible to a host connection on port 2 that had an offset of 120 as LUN 7 (unit number of 127 minus offset of 120). The unit would not be visible to a host connection with a unit offset of 128 or greater, because that offset is not within the unit's range (unit number of 127 minus offset of 128 is a negative number).

An additional factor to consider when assigning unit numbers and offsets is SCSI version. If the SCSI_VERSION switch of the SET THIS_CONTROLLER/OTHER_CONTROLLER command is set to SCSI-3, the CCL is presented as LUN 0 to every connection, superseding any unit assignments. The interaction between SCSI version and unit numbers is explained further in the next section.

In addition, the access path to the host connection must be enabled for the connection to access the unit. See "Restricting Host Access in Transparent Failover Mode", page 46.

Assigning Unit Numbers Depending on SCSI_VERSION

The SCSI_VERSION switch of the SET THIS_CONTROLLER/OTHER_CONTROLLER command determines how the CCL is presented. There are two choices: SCSI-2 and SCSI-3. The choice for SCSI_VERSION affects how certain unit numbers and certain host connection offsets interact.

Note: Linux requires the controllers be set to SCSI-3 mode.

Assigning Host Connection Offsets and Unit Numbers in SCSI-3 Mode

If SCSI_VERSION is set to SCSI-3, the CCL is presented as LUN 0 to all connections. The CCL supersedes any other unit assignment. Therefore, in SCSI-3 mode, a unit that would normally be presented to a connection as LUN 0 is not visible to that connection at all.

The following methods are recommended for assigning host connection offsets and unit numbers in SCSI-3 mode:

- Offsets should be divisible by 10 (for consistency and simplicity).
- Unit numbers should not be assigned at connection offsets (to avoid being masked by the CCL at LUN 0).

For example, if a host connection has an offset of 20 and SCSI-3 mode is selected, the connection sees LUNs as follows:

LUN 0—CCL

LUN 1—unit 21

LUN 2—unit 22, etc.

In this example, if a unit 20 is defined, it is superseded by the CCL and invisible to the connection.

Assigning Host Connection Offsets and Unit Numbers in SCSI-2 Mode

Some operating systems expect or require a disk unit to be at LUN 0. In this case, it is necessary to specify SCSI-2 mode.

If SCSI_VERSION is set to SCSI-2 mode, the CCL floats, moving to the first available LUN location, depending on the configuration.

HP recommends that you use the following conventions when assigning host connection offsets and unit numbers in SCSI-2 mode:

- Offsets should be divisible by 10 (for consistency and simplicity).
- Unit numbers should be assigned at connection offsets (so that every host connection has a unit presented at LUN 0).

Table 3 summarizes the recommendations for unit assignments based on the SCSI_VERSION switch.

Table 3: Unit assignments and SCSI_VERSION

SCSI_VERSION	Offset	Unit Assignment	What the connection sees LUN 0 as
SCSI-2	Divisible by 10	At offsets	Unit whose number matches offset
SCSI-3	Divisible by 10	Not at offsets	CCL

What is Selective Storage Presentation?

Selective Storage presentation is a feature of the HSG80 controller that enables you to control the allocation of storage space and shared access to storage across multiple hosts. This is also known as *Restricting Host Access*.

In a subsystem that is attached to more than one host or if the hosts have more than one adapter, it is possible to reserve certain units for the exclusive use of certain host connections.

For a controller pair, the method used to restrict host access depends on whether the controllers are in transparent or multiple-bus failover mode. For a single controller, the methods are the same as for a controller pair in transparent failover.

The default condition is `ENABLE_ACCESS_PATH=ALL`. This specifies that access paths to ALL hosts are enabled. HP recommends that you restrict host access and that the access path be carefully specified to avoid providing undesired host connections access to the unit.

Now with V8.8-1 you may change the subsystem behavior so that units are always created without enabling connections. This provides more control in granting appropriate access to specific connections.

The command syntax to disable is:

```
HSG> SET this/other Default_Access=Disable
```

The command syntax to enable is:

`HSG> SET Default this/other Default_Access=Enable` (default after upgrade)

When the command is invoked from one controller, the Default_Access from the other controller will be similarly modified. The setting is symmetrical and persistent across restarts, FRUTIL, etc.

Restricting Host Access in Transparent Failover Mode

Three methods can be used to restrict host access to storage units in transparent failover mode:

- Using separate Fibre Channel links (either loop or fabric)
- Enabling the access path of selected host connections on a shared loop or fabric
- Setting offsets

Note: These techniques also work for a single controller.

Restricting Host Access by Separate Links

In transparent failover mode, host port 1 of controller A and host port 1 of controller B share a common Fibre Channel link. Host port 2 of controller A and host port 2 of controller B also share a common Fibre Channel link. If the host 1 link is separate from the host 2 link, the simplest way to limit host access is to have one host or set of hosts on the port 1 link, and another host or set of hosts on the port 2 link. Each host can then see only units assigned to its respective controller port. This separation of host buses is shown in Figure 14. This method applies only if the host 1 link and host 2 link are separate links.

Note: It is highly recommended that you provide access to only specific connections. This way, if new connections are added, they do not have automatic access to all units. See the following section "Restricting Host Access by Disabling Access Paths" on page 48.

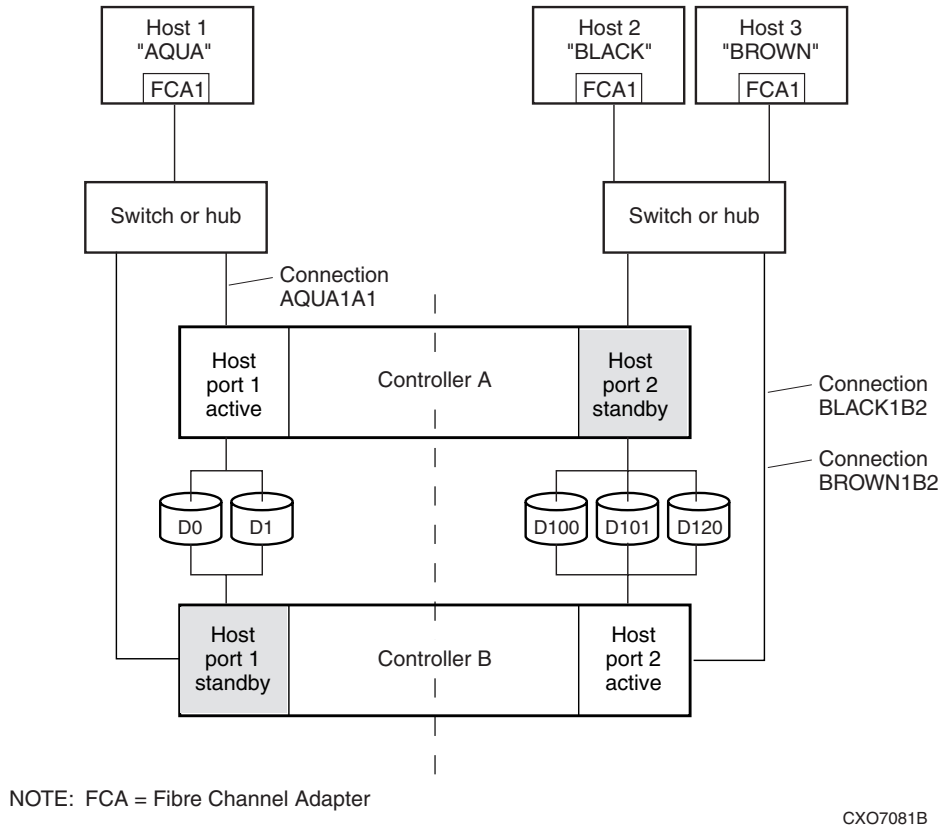


Figure 14: Limiting host access in transparent failover mode

Restricting Host Access by Disabling Access Paths

If more than one host is on a link (that is, attached to the same port), host access can be limited by enabling the access of certain host connections and disabling the access of others. This is done through the ENABLE_ACCESS_PATH and DISABLE_ACCESS_PATH switches of the ADD UNIT (or SET *unit*) commands. The access path is a unit switch, meaning it must be specified for each unit. Default access enables the unit to be accessible to all hosts.

For example:

In Figure 15, restricting the access of unit D101 to host 3, the host named BROWN can be done by enabling only the connection to host 3. Enter the following commands:

```
SET D101 DISABLE_ACCESS_PATH=ALL
SET D101 ENABLE_ACCESS_PATH=BROWN1B2
```

If the storage subsystem has more than one host connection, carefully specify the access path to avoid providing undesired host connections access to the unit. The default condition for a unit is that access paths to all host connections are enabled. To restrict host access to a set of host connections, specify DISABLE_ACCESS_PATH=ALL for the unit, then specify the set of host connections that are to have access to the unit.

Enabling the access path to a particular host connection does not override previously enabled access paths. All access paths previously enabled are still valid; the new host connection is simply added to the list of connections that can access the unit.

Note: The procedure of restricting access by enabling all access paths then disabling selected paths is **not recommended** because of the potential data/security breach that occurs when a new host connection is added.

Restricting Host Access by Offsets

Offsets establish the start of the range of units that a host connection can access.

For example:

In Figure 14, assume both host connections on port 2 (connections BLACK1B2 and BROWN1B2) initially have the default port 2 offset of 100. Setting the offset of connection BROWN1B2 to 120 presents unit D120 to host BROWN as LUN 0.

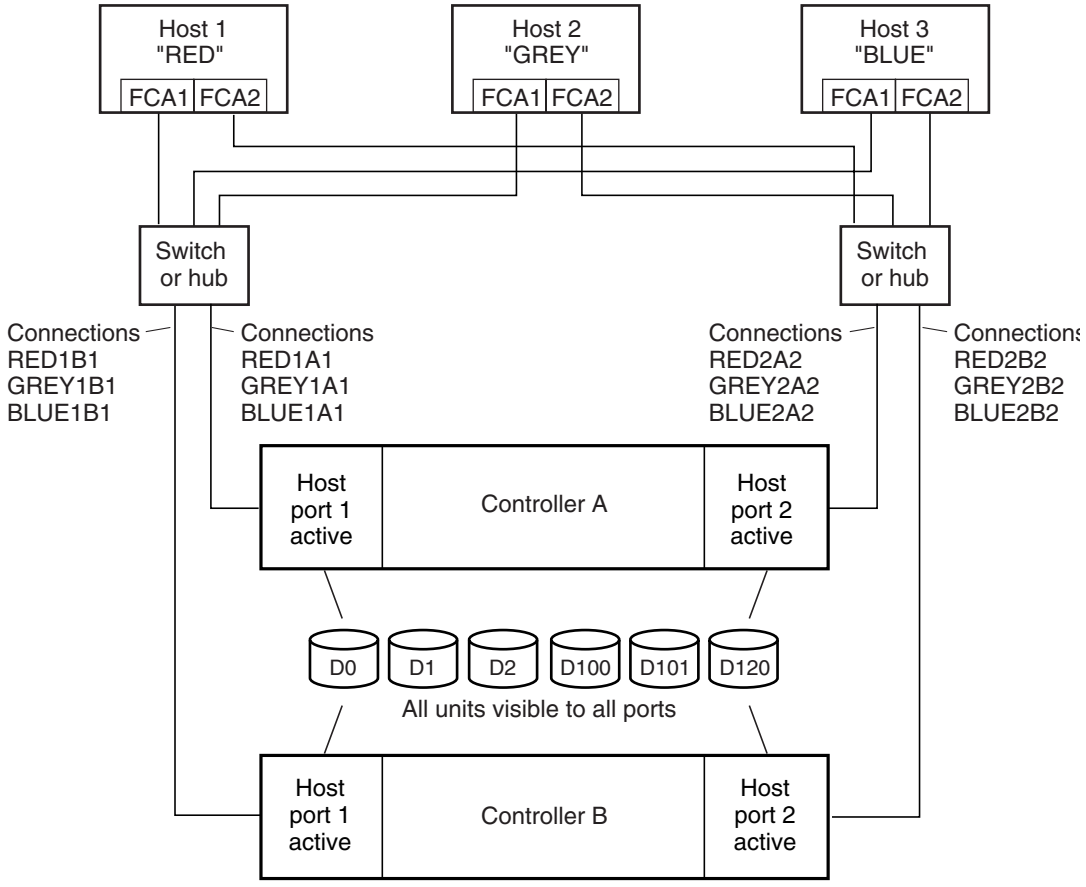
```
SET BROWN1B2 UNIT_OFFSET=120
```

Host BROWN cannot see units lower than its offset, so it cannot access units D100 and D101. However, host BLACK can still access D120 as LUN 20 if the operating system permits. To restrict access of D120 to only host BROWN, enable only host BROWN's access, as follows:

```
SET D120 DISABLE_ACCESS_PATH=ALL
SET D120 ENABLE_ACCESS_PATH=BROWN1B2
```

Note: HP recommends that you provide access to only specific connections, even if there is just one connection on the link. This way, if new connections are added, they do not have automatic access to all units.

Figure 15: Limiting host access in multiple-bus failover mode



NOTE: FCA = Fibre Channel Adapter

CXO7078

Worldwide Names (Node IDs and Port IDs)

A worldwide name—also called a node ID—is a unique, 64-bit number assigned to a subsystem prior to shipping. The node ID belongs to the subsystem itself and never changes.

Each subsystem's node ID ends in zero, for example 5000-1FE1-FF0C-EE00. The controller port IDs are derived from the node ID.

In a subsystem with two controllers in transparent failover mode, the controller port IDs are incremented as follows:

- Controller A and controller B, port 1—worldwide name + 1, for example 5000-1FE1-FF0C-EE01
- Controller A and controller B, port 2—worldwide name + 2, for example 5000-1FE1-FF0C-EE02

Use the CLI command, `SHOW THIS_CONTROLLER/OTHER_CONTROLLER` to display the subsystem's worldwide name.

Restoring Worldwide Names (Node IDs)

If a situation occurs that requires you to restore the worldwide name, you can restore it using the worldwide name and checksum printed on the sticker on the frame into which the controller is inserted.

Figure 16 shows the placement of the worldwide name label for the Model 2200 enclosure, and Figure 17 shows the placement for the BA370 enclosure.

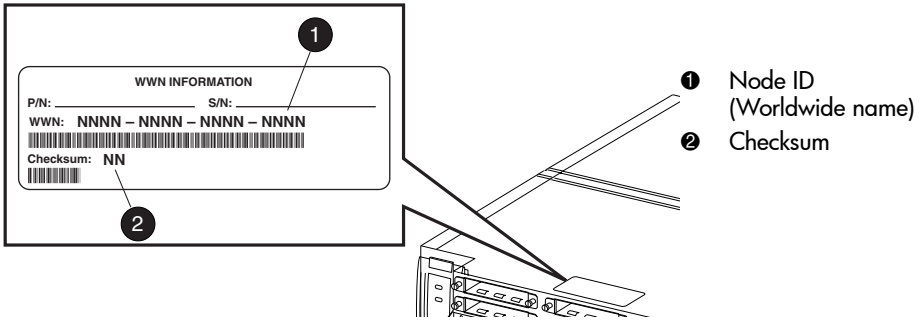


Figure 16: Placement of the worldwide name label on the Model 2200 enclosure

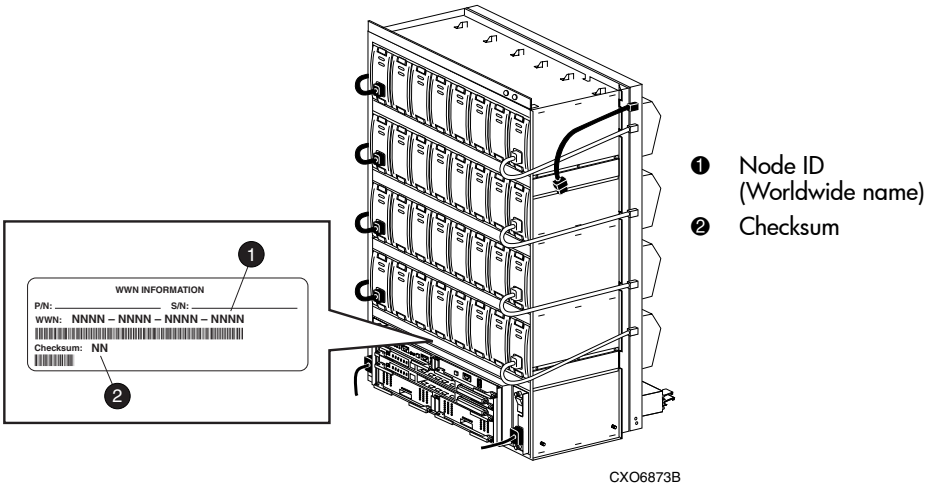


Figure 17: Placement of the worldwide name label on the BA370 enclosure

Caution: Each subsystem has its own unique worldwide name (node ID). If you attempt to set the subsystem worldwide name to a name other than the one that came with the subsystem, the data on the subsystem is not accessible. Never set two subsystems to the same worldwide name, or data corruption occurs.

Unit Worldwide Names (LUN IDs)

In addition, each unit has its own worldwide name, or LUN ID. This is a unique, 128-bit value that the controller assigns at the time of unit initialization. It cannot be altered by you but does change when the unit is reinitialized. Use the `SHOW` command to list the LUN ID.

Planning Storage Configurations

2

This chapter provides information to help you plan the storage configuration of your subsystem. Storage containers are individual disk drives (JBOD), storageset types (mirrorsets, stripesets, and so on), and/or partitioned drives. Use the guidelines found in this section to plan the various types of storage containers needed.

This chapter also focuses on the required design and implementation aspects, such as addressing conventions, configuration rules, creating storage profiles, and creating storage maps.

The following storage configuration information can be found in this chapter:

Refer to Chapter 3 for instructions on how to prepare your host computer to accommodate the HSG80 controller storage subsystem.

Where to Start

The following procedure outlines the steps to follow when planning your storage configuration.

See Appendix A to locate the blank templates for keeping track of the containers being configured.

1. Determine your storage requirements. Use the questions in "Determining Storage Requirements", page 58, to help you.
2. Review configuration rules. See "Configuration Rules for the Controller", page 59.
3. Familiarize yourself with the current physical layout of the devices and their addressing scheme. See "Addressing Conventions for Device PTL", page 62.
4. Choose the type of storage containers you need to use in your subsystem. See "Choosing a Container Type", page 71, for a comparison and description of each type of storageset.
5. Create a storageset profile (described in "Creating a Storageset Profile", page 73). Fill out the storageset profile while you read the sections that pertain to your chosen storage type:
   - "Planning Considerations for Storageset", page 75
   - "Mirrorset Planning Considerations", page 77
   - "RAIDset Planning Considerations", page 79
   - "Partition Planning Considerations", page 83
   - "Striped Mirrorset Planning Considerations", page 81
6. Decide which switches you need for your subsystem. General information on switches is detailed in "Specifying Storageset and Partition Switches", page 86.
   - Determine the unit switches you want for your units ("Specifying Unit Switches", page 92).
   - Determine the initialization switches you want for your planned storage containers ("Specifying Initialization Switches", page 88).
7. Create a storage map ("Creating Storage Maps", page 93).
8. Configure the storage you have now planned using one of the following methods:
   - Use SWCC. See the SWCC documentation for details.

— Use the Command Line Interpreter (CLI) commands. This method allows you flexibility in defining and naming your storage containers. See the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide*.

Determining Storage Requirements

It is important to determine your storage requirements. Here are a few of the questions you should ask yourself regarding the subsystem usage:

- What applications or user groups access the subsystem? How much capacity do they need?
- What are the I/O requirements? If an application is data transfer-intensive, what is the required transfer rate? If it is I/O request-intensive, what is the required response time? What is the read/write ratio for a typical request?
- Are most I/O requests directed to a small percentage of the disk drives? Do you want to keep it that way or balance the I/O load?
- Do you store mission-critical data? Is availability the highest priority or would standard backup procedures suffice?

Configuration Rules for the Controller

The following list defines maximum configuration rules for the controller:

- 128 visible LUNs/200 assignable unit numbers
  - In SCSI-3 mode, if the CCL is enabled, the result is 126 visible LUNs and two CCLs.

Note: In SCSI-2 mode, if the Command Console LUN (CCL) is enabled, and in SCSI-3 mode where the CCL is always enabled, the result is 127 visible LUNs and one CCL.

- 1.024 TB storageset size
- 96 host connections
- 72 physical devices for BA370-based packaging; 84 physical devices for all others
- 20 RAID 3/5 storagesets
- 30 RAID 3/5 and RAID 1 storagesets (see note)
- 45 RAID 3/5, RAID 1, and RAID 0 storagesets (see note)

Note: For the previous two storageset configurations, this is a combined maximum, limited to no more than 20 RAID 3/5 storagesets in the individual combination.

- 8 partitions of a storageset or individual disk
- 6 physical devices per RAID 1 storageset (mirrorset)
- 14 physical devices per RAID 3/5 storageset (RAIDset)
- 24 physical devices per RAID 0 storageset (stripeset)
- 48 physical devices per RAID 0+1 storageset (striped mirrorset)
- 146 GB disks (for universal drives only) are the largest supported for the HSG60 and HSG80 storage array.

Tip: If you are redeploying disks that have been operating under a prior version of ACS into a newly established container, as a best practice, *always* initialize the devices and the new container before proceeding with subsystem activities to avoid operational and performance issues.

Configuring Large Storagesets

When creating large storagesets, the logical geometry presented by the array controller may be outside the limits of the operating system. When this occurs, your storageset is reported by the operating system as having a smaller size than is correct.

If one of your storagesets is significantly smaller than you expect, the operating system may be reporting the logical geometry of the storageset incorrectly. One of the more common instances of this phenomenon occurs when the cylinder count exceeds 65535, which causes it to "wrap around." This problem can be easily remedied by bringing the logical geometry, as presented by the controller, within the bounds of the operating system. To bring the logical geometry within bounds, use the ACS `INITIALIZE` command with the appropriate combination of the CYLINDERS, HEADS and SECTORS_PER_TRACK qualifiers.

The following example shows the steps to take:

1. Note the size and geometry information of the storageset using the `SHOW unit-number` command.

   ```
   HSG80> SHOW D101
   ```

   Executing this command reports the size (in blocks) and geometry of the storageset. For example:

Size:	80913640
Geometry (C/H/S):	74983 / 20 / 254

   Note that the geometry values may be rounded, so that the formula:

   ```
   cylinders x heads x sectors
   ```

   may not yield the exact number for the size in blocks. When performing calculations, always ensure that the product of the above formula is no greater than the original size of the storageset in blocks (i.e., make sure that the logical geometry is no greater than the physical geometry).

2. Calculate the new values for the geometry by dividing the quantity which is too large by the same amount that is used to multiply one of the other quantities. Quite often the cylinders count is too large, and the heads count can be adjusted upward. During this process, ensure that the formula `cylinders x heads x sectors` remains constant. In this example, divide the cylinders count by 2 and multiply the heads count by 2 to get the following values:

Size:	380908560
Geometry (C/H/S):	37491 / 40 / 254

   Note that the resulting size is slightly smaller.

3. Delete the unit, so that the storageset can be re-initialized:

   ```
   HSG80> DELETE D101
   ```

4. Initialize the storageset with the new values:

   ```
   HSG80> INITIALIZE R0 CYLINDERS=37491 HEADS=40
   ```

   Be sure to use the same additional qualifiers as when the storageset was first initialized.

5. Add the unit:

   ```
   HSG80> ADD UNIT D101 R0
   ```

At this point, verify that the value is correct with the `SHOW` command.

Upon completion of the above steps you are able to format the storageset and create a file system.

Addressing Conventions for Device PTL

The HSG80 controller has six SCSI device ports, each of which connects to a SCSI bus. In dual-controller subsystems, these device buses are shared between the two controllers. (The StorageWorks Command Console calls the device ports "channels.") The standard BA370 enclosure provides a maximum of four SCSI target identifications (ID) for each device port. If more target IDs are needed, expansion enclosures can be added to the subsystem. For an example of how units are mapped to physical disk drives, see Figure 18.

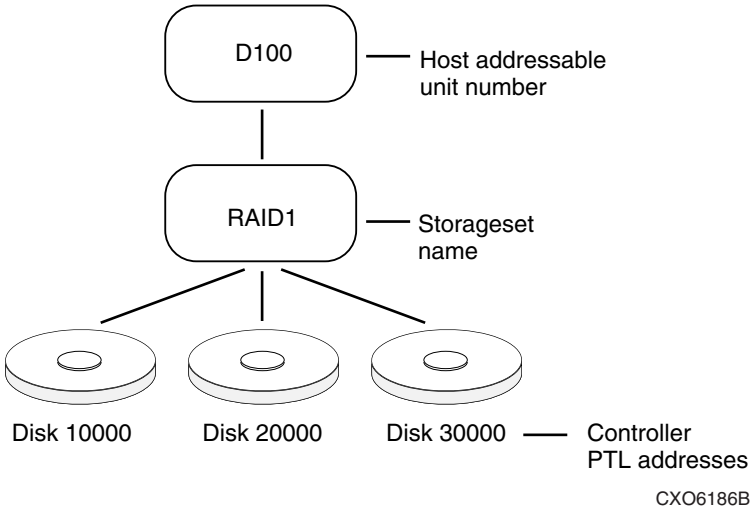


Figure 18: Mapping a unit to physical disk drives

The HSG80 controller identifies devices based on a Port-Target-LUN (PTL) numbering scheme, shown in Figure 19. The physical location of a device in its enclosure determines its PTL.

- P—Designates the controller's SCSI device port number (1 through 6).
- T—Designates the target ID number of the device. Valid target ID numbers for a single-controller configuration and dual-redundant controller configuration are 0–3 and 8–15, respectively. (This applies to the BA370 cabinet only.)

- L—Designates the logical unit (LUN) of the device. For disk devices the LUN is always 0.

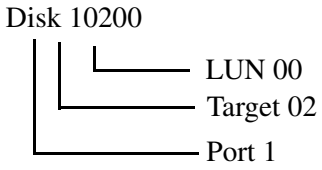


Figure 19: PTL naming convention

The controller can either operate with a BA370 enclosure or with a Model 2200 controller enclosure combined with Model 4214R, Model 4254, Model 4310R, Model 4350R, Model 4314R, or Model 4354R disk enclosures.

The controller operates with BA370 enclosures that are assigned ID numbers 0, 2, and 3. These ID numbers are set through the PVA module. Enclosure ID number 1, which assigns devices to targets 4 through 7, is not supported. Figure 20 shows how data is laid out on disks in an extended configuration.

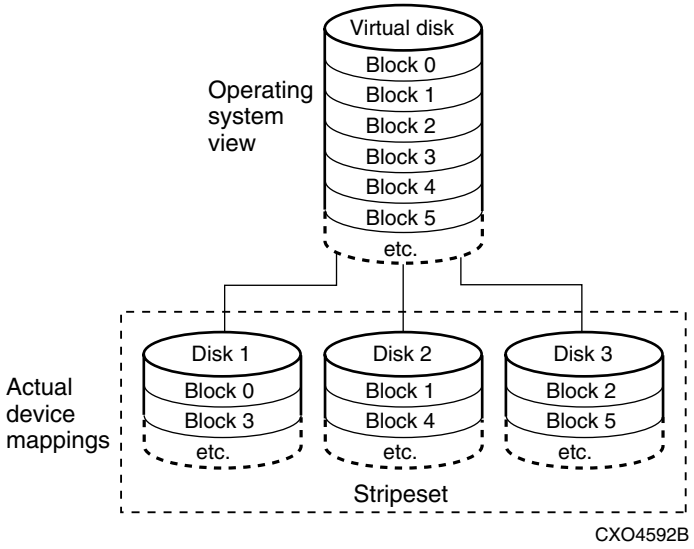


Figure 20: How data is laid out on disks in BA370 enclosure configuration

Examples - Model 2200 Storage Maps, PTL Addressing

The Model 2200 controller enclosure can be combined with the following:

- **Model 4214R disk enclosure**—Ultra2 SCSI with 14 drive bays, single-bus I/O module.
- **Model 4254 disk enclosure**—Ultra2 SCSI with 14 drive bays, dual-bus I/O module.

Note: The Model 4214R uses the same storage maps as the Model 4314R, and the Model 4254 uses the same storage maps as the Model 4354R disk enclosures.

- **Model 4310R disk enclosure**—Ultra3 SCSI with 10 drive bays, single-bus I/O module. Table 4 shows the addresses for each device in a six-shelf, single-bus configuration. A maximum of six Model 4310R disk enclosures can be used with each Model 2200 controller enclosure.

Note: The storage map for the Model 4310R reflects the disk enclosure's physical location in the rack. Disk enclosures 6, 5, and 4 are stacked above the controller enclosure, and disk enclosures 1, 2, and 3 are stacked below the controller enclosure.

- **Model 4350R disk enclosure**—Ultra3 SCSI with 10 drive bays, single-bus I/O module. Table 5 shows the addresses for each device in a three-shelf, single-bus configuration. A maximum of three Model 4350R disk enclosures can be used with each Model 2200 controller enclosure.
- **Model 4314R disk enclosure**—Ultra3 SCSI with 14 drive bays, single-bus I/O module. Table 6 shows the addresses for each device in a six-shelf, single-bus configuration. A maximum of six Model 4314R disk enclosures can be used with each Model 2200 controller enclosure.

Note: The storage map for the Model 4314R reflects the disk enclosure's physical location in the rack. Disk enclosures 6, 5, and 4 are stacked above the controller enclosure, and disk enclosures 1, 2, and 3 are stacked below the controller enclosure.

- **Model 4354R disk enclosure**—Ultra3 SCSI with 14 drive bays, dual-bus I/O module. Table 7 shows the addresses for each device in a three-shelf, dual-bus configuration. A maximum of three Model 4354R disk enclosures can be used with each Model 2200 controller enclosure.

Note: Appendix A contains storageset profiles you can copy and use to create your own system profiles. It also contains an enclosure template you can use to help you keep track of the location of devices and storagesets in your shelves.

Table 4: PTL addressing, single-bus configuration, six Model 4310R enclosures

Model 4310R Disk Enclosure Shelf 6 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800	Disk61000	Disk61100	Disk61200
Model 4310R Disk Enclosure Shelf 5 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk51000	Disk51100	Disk51200

Model 4310R Disk Enclosure Shelf 4 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800	Disk41000	Disk41100	Disk41200
Model 4310R Disk Enclosure Shelf 1 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk11000	Disk11100	Disk11200
Model 4310R Disk Enclosure Shelf 2 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800	Disk21000	Disk21100	Disk21200
Model 4310R Disk Enclosure Shelf 3 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk31000	Disk31100	Disk31200

Table 5: PTL addressing, dual-bus configuration, three Model 4350R enclosures

Model 4350R Disk Enclosure Shelf 1 (Single-bus)										
	SCSI Bus A					SCSI Bus B				
Bay	1	2	3	4	5	6	7	8	9	10
SCSI ID	00	01	02	03	04	00	01	02	03	04
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400

Model 4350R Disk Enclosure Shelf 2 (Single-bus)										
	SCSI Bus A					SCSI Bus B				
Bay	1	2	3	4	5	6	7	8	9	10
SCSI ID	00	01	02	03	04	00	01	02	03	04
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400

	SCSI Bus A					SCSI Bus B				
Bay	1	2	3	4	5	6	7	8	9	10
SCSI ID	00	01	02	03	04	00	01	02	03	04
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400

Table 6: PTL addressing, single-bus configuration, six Model 4314R enclosures

Model 4314R Disk Enclosure Shelf 6 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800	Disk60900	Disk61000	Disk61100	Disk61200	Disk61300	Disk61400	Disk61500
Model 4314R Disk Enclosure Shelf 5 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk50900	Disk51000	Disk51100	Disk51200	Disk51300	Disk51400	Disk51500
Model 4314R Disk Enclosure Shelf 4 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800	Disk40900	Disk41000	Disk41100	Disk41200	Disk41300	Disk41400	Disk41500
Model 4314R Disk Enclosure Shelf 1 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk10900	Disk11000	Disk11100	Disk11200	Disk11300	Disk11400	Disk11500

Model 4314R Disk Enclosure Shelf 2 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800	Disk20900	Disk21000	Disk21100	Disk21200	Disk21300	Disk21400	Disk21500
Model 4314R Disk Enclosure Shelf 3 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk30900	Disk31000	Disk31100	Disk31200	Disk31300	Disk31400	Disk31500

Table 7: PTL addressing, dual-bus configuration, three Model 4354A enclosures.

Model 4354R Disk Enclosure Shelf 1 (Dual-bus)														
	SCSI Bus A							SCSI Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800

Model 4354R Disk Enclosure Shelf 2 (Dual-bus)														
	SCSI Bus A							SCSI Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800

Model 4354R Disk Enclosure Shelf 3 (Dual-bus)														
	SCSI Bus A							SCSI Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800

Choosing a Container Type

Different applications may have different storage requirements. You probably want to configure more than one kind of container within your subsystem.

In choosing a container, you choose between independent disks (JBODs) or one of several storageset types, as shown in Figure 21. The independent disks and the selected storageset may also be partitioned.

The storagesets implement RAID (Redundant Array of Independent Disks) technology. Consequently, they all share one important feature: each storageset, whether it contains two disk drives or ten, looks like one large, virtual disk drive to the host.

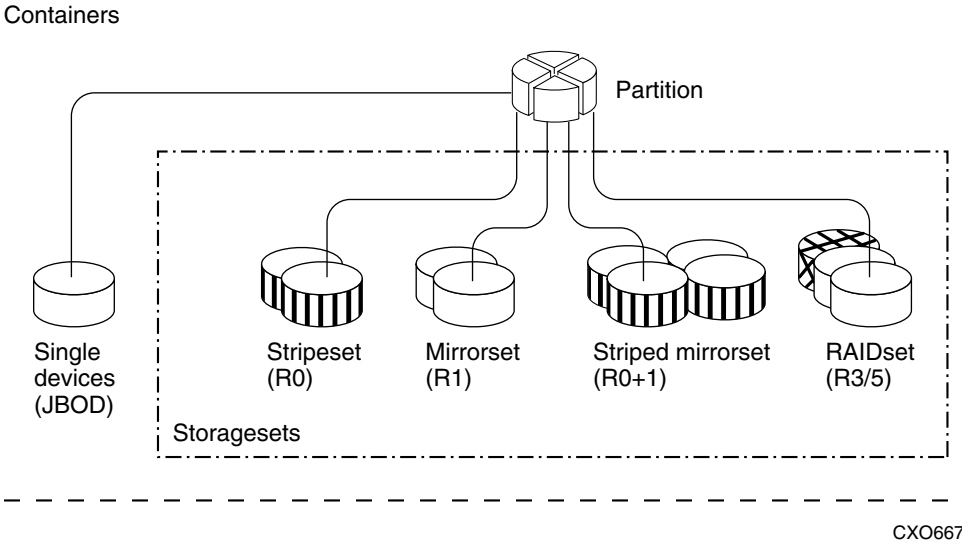


Figure 21: Storage container types

Table 8 compares the different kinds of containers to help you determine which ones satisfy your requirements.

Table 8: Comparison of container types

Container Name	Relative Availability	Request Rate (Read/Write) I/O Per Second	Transfer Rate (Read/Write) MB Per Second	Applications
Independent disk drives (JBOD)	Equal to number of JBOD disk drives	Comparable to single disk drive	Comparable to single disk drive	—
Stripeset (RAID 0)	Proportionate to number of disk drives; worse than single disk drive	Excellent if used with large chunk size	Excellent if used with small chunk size	High performance for non-critical data
Mirrorset (RAID1)	Excellent	Good/Fair	Good/Fair	System drives; critical files
RAIDset (RAID 3/5)	Excellent	Excellent/good	Read: excellent (if used with small chunk sizes) Write: good (if used with small chunk sizes)	High request rates, read-intensive, data lookup
Striped Mirrorset (RAID 0+1)	Excellent	Excellent if used with large chunk size	Excellent if used with small chunk size	Any critical response-time application

For a comprehensive discussion of RAID, refer to *The RAIDBOOK—A Source Book for Disk Array Technology.*

Creating a Storageset Profile

Creating a profile for your storagesets, partitions, and devices can simplify the configuration process. Filling out a storageset profile helps you choose the storagesets that best suit your needs and to make informed decisions about the switches you can enable for each storageset or storage device that you configure in your subsystem.

For an example of a storageset profile, see Table 9. This table contains blank profiles that you can copy and use to record the details for your storagesets. Use the information in this chapter to help you make decisions when creating storageset profiles.

Table 9: Example of storageset profile

Type of Storageset:				
_____ Mirrorset	__X_ RAIDset	_____ Stripeset	_____ Striped Mirrorset	____ JBOD

Storageset Name *R1.* **Disk Drives** *D10300, D20300, D10400, D20400*

Unit Number *D101*

Partitions:

Unit #	Unit #	Unit #	Unit #	Unit #	Unit #	Unit #	Unit #
%	%	%	%	%	%	%	%

RAIDset Switches:

Reconstruction Policy	Reduced Membership	Replacement Policy
_X_Normal (default)	_X__No (default)	_X_Best performance (default)
___Fast	___Yes, missing:	___Best fit
		___None

Mirrorset Switches:

Replacement Policy	Copy Policy	Read Source
___Best performance (default)	___Normal (default)	___Least busy (default)
___Best fit	___Fast	___Round robin
___None		___Disk drive:

Initialize Switches:

Chunk size	Save Configuration	Metadata
_X_ Automatic (default)	___No (default)	_X_Destroy (default)
___ 64 blocks	_X_ Yes	___Retain
___ 128 blocks		
___ 256 blocks		

Unit Switches:

Caching	Access by following hosts enabled
Read caching_____X__	_ALL_____
Read-ahead caching_____	_____
Write-back caching___X__	_____
Write-through caching____	_____

Planning Considerations for Storageset

This section contains the guidelines for choosing the storageset type needed for your subsystem:

Stripeset Planning Considerations

Stripesets (RAID 0) enhance I/O performance by spreading the data across multiple disk drives. Each I/O request is broken into small segments called “chunks.” These chunks are then simultaneously “striped” across the disk drives in the storageset, thereby enabling several disk drives to participate in one I/O request.

For example, in a three-member stripeset that contains disk drives Disk 10000, Disk 20000, and Disk 10100, the first chunk of an I/O request is written to Disk 10000, the second to Disk 20000, the third to Disk 10100, the fourth to Disk 10000, until all of the data has been written to the drives (Figure 22).

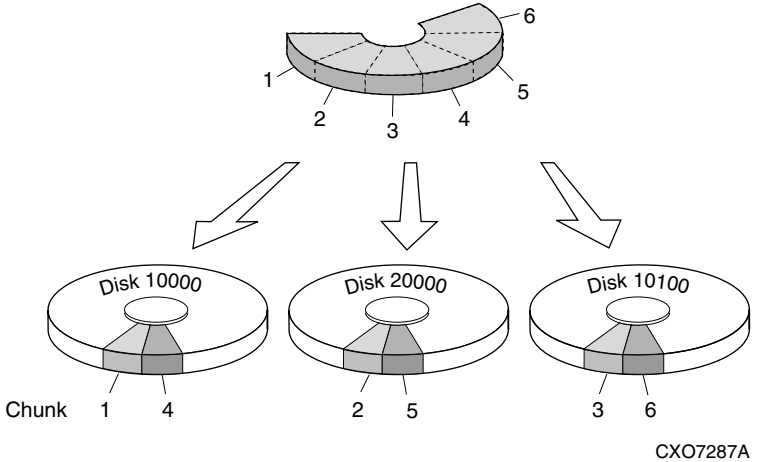


Figure 22: Three-member RAID 0 stripeset (example 1)

The relationship between the chunk size and the average request size determines if striping maximizes the request rate or the data-transfer rate. You can set the chunk size or use the default setting (see "Chunk Size", page 88, for information about setting the chunk size). Figure 23 shows another example of a three-member RAID 0 stripeset.

A major benefit of striping is that it balances the I/O load across all of the disk drives in the storageset. This can increase the subsystem performance by eliminating the hot spots (high localities of reference) that occur when frequently accessed data becomes concentrated on a single disk drive.

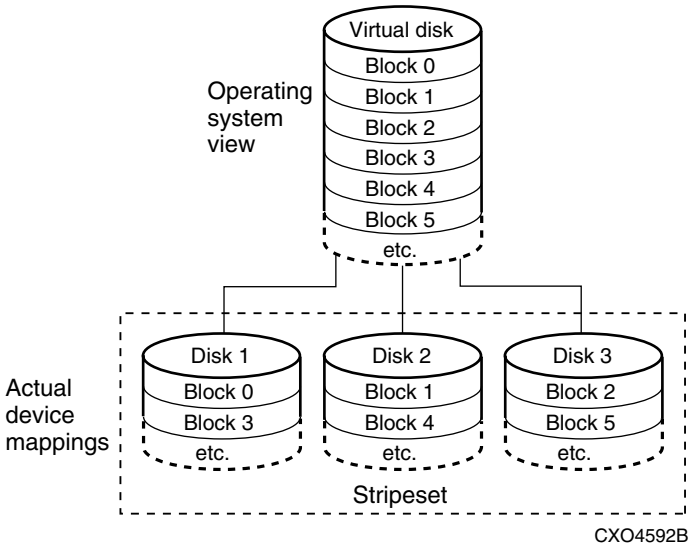


Figure 23: Three-member RAID 0 stripeset (example 2)

Keep the following points in mind as you plan your stripesets:

- Reporting methods and size limitations prevent certain operating systems from working with large stripesets.
- A storageset should only contain disk drives of the same capacity. The controller limits the effective capacity of each member to the capacity of the smallest member in the storageset (base member size) when the storageset is initialized. Thus, if you combine 9 GB disk drives with 4 GB disk drives in the same storageset, you waste 5 GB of capacity on each 9 GB member.

  If you need high performance and high availability, consider using a RAIDset, striped-mirrorset, or a host-based shadow of a stripeset.

- Striping does not protect against data loss. In fact, because the failure of one member is equivalent to the failure of the entire stripeset, the likelihood of losing data is higher for a stripeset than for a single disk drive.

  For example, if the mean time between failures (MTBF) for a single disk is l hour, then the MTBF for a stripeset that comprises N such disks is l/N hours. As another example, if the MTBF of a a single disk is 150,000 hours (about 17 years), a stripeset comprising four of these disks would only have an MTBF of slightly more than 4 years.

  For this reason, you should avoid using a stripeset to store critical data. Stripesets are more suitable for storing data that can be reproduced easily or whose loss does not prevent the system from supporting its critical mission.
- Evenly distribute the members across the device ports to balance the load and provide multiple paths.
- Stripesets may contain between two and 24 members.
- If you plan to use mirror members to replace failing drives, then create the original stripeset as a stripeset of 1-member mirrorsets.
- Stripesets are well-suited for the following applications:
  - Storing program image libraries or run-time libraries for rapid loading.
  - Storing large tables or other structures of read-only data for rapid application access.
  - Collecting data from external sources at very high data transfer rates.
- Stripesets are not well-suited for the following applications:
  - A storage solution for data that cannot be easily reproduced or for data that must be available for system operation.
  - Applications that make requests for small amounts of sequentially located data.
  - Applications that make synchronous random requests for small amounts of data.

Spread the member drives as evenly as possible across the six I/O device ports.

Mirrorset Planning Considerations

Mirrorsets (RAID 1) use redundancy to ensure availability, as illustrated in Figure 24. For each primary disk drive, there is at least one mirror disk drive. Thus, if a primary disk drive fails, its mirror drive immediately provides an exact copy of the data. Figure 25 shows a second example of a mirrorset.

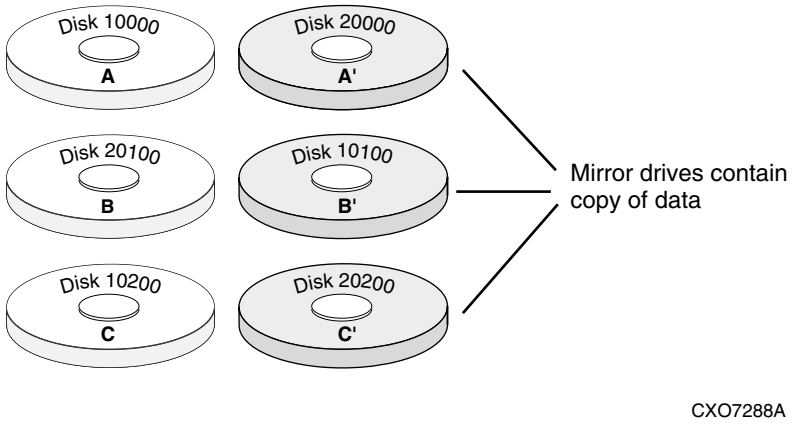


Figure 24: Mirrorsets maintain two copies of the same data

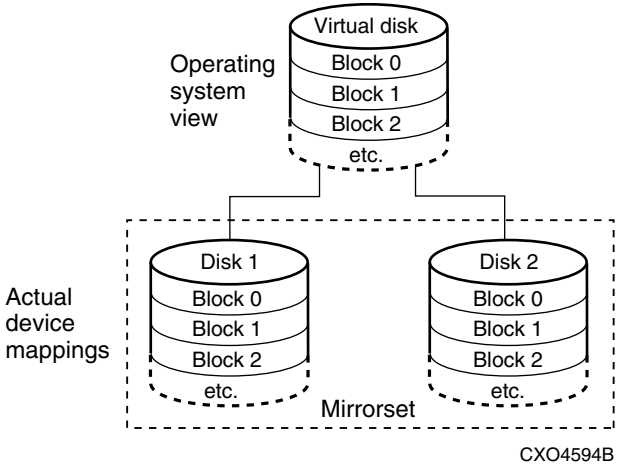


Figure 25: Mirrorset example 2

Keep these points in mind when planning mirrorsets:

- Data availability with a mirrorset is excellent but comes with a higher cost—you need twice as many disk drives to satisfy a given capacity requirement. If availability is your top priority, consider using dual-redundant controllers and redundant power supplies.

- You can configure up to a maximum of 20 RAID 3/5 mirrorsets per controller or pair of dual-redundant controllers. Each mirrorset may contain up to 6 members. Refer to "Configuration Rules for the Controller", page 59, for detailed information on maximum numbers. 30 RAID 3/5 and RAID 1 mirrorsets are permitted, however, there is limit of no more than 20 RAID 3/5 mirrorsets in such a configuration.
- Both write-back cache modules must be the same size.
- A mirrorset should only contain disk drives of the same capacity.
- Spread mirrorset members across different device ports (drive bays).
- Mirrorsets are well-suited for the following:
  - Any data for which reliability requirements are extremely high
  - Data to which high-performance access is required
  - Applications for which cost is a secondary issue
- Mirrorsets are not well-suited for the following applications:
  - Write-intensive applications (a performance hit of 10 percent occurs)
  - Applications for which cost is a primary issue

RAIDset Planning Considerations

RAIDsets (RAID 3/5) are enhanced stripesets—they use striping to increase I/O performance and distributed-parity data to ensure data availability. Figure 26 shows an example of a RAIDset that uses five members.

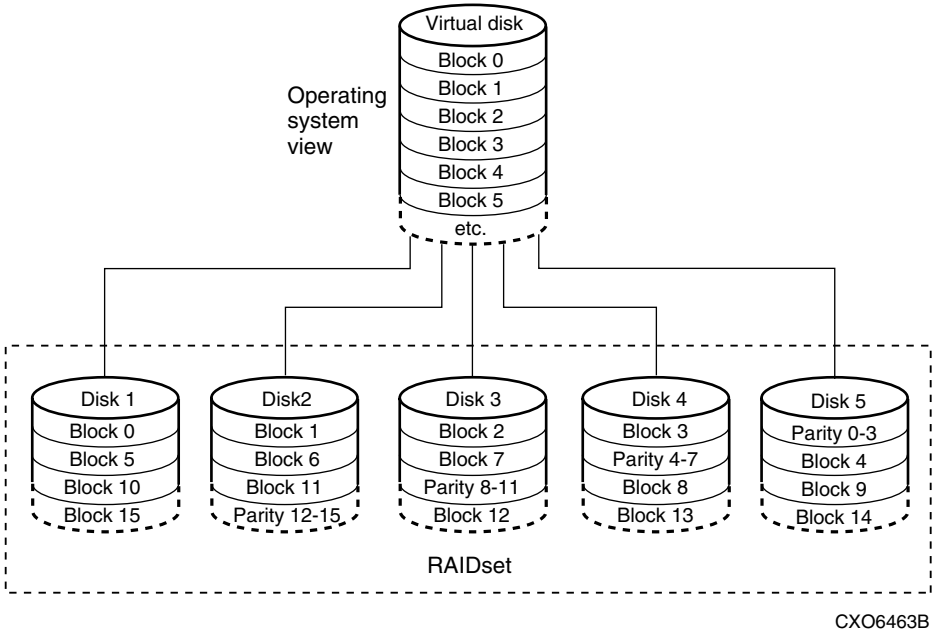


Figure 26: Five-member RAIDset using parity

RAIDsets are similar to stripesets in that the I/O requests are broken into smaller "chunks" and striped across the disk drives. RAIDsets also create chunks of parity data and stripe them across all the members of the RAIDset. Parity data is derived mathematically from the I/O data and enables the controller to reconstruct the I/O data if a single disk drive fails. Thus, it becomes possible to lose a disk drive without losing access to the data it contained. Data could be lost if a second disk drive fails before the controller replaces the first failed disk drive and reconstructs the data.

The relationship between the chunk size and the average request size determines if striping maximizes the request rate or the data-transfer rates. You can set the chunk size or use the default setting. See "Chunk Size", page 88, for information about setting the chunk size.

Keep these points in mind when planning RAIDsets:

- Reporting methods and size limitations prevent certain operating systems from working with large RAIDsets.
- Both cache modules must be the same size.

- A RAIDset must include at least 3 disk drives, but no more than 14.
- A storageset should only contain disk drives of the same capacity. The controller limits the capacity of each member to the capacity of the smallest member in the storageset. Thus, if you combine 9 GB disk drives with 4 GB disk drives in the same storageset, you waste 5 GB of capacity on each 9 GB member.
- RAIDsets are particularly well-suited for the following:
  - Small to medium I/O requests
  - Applications requiring high availability
  - High read request rates
  - Inquiry-type transaction processing
- RAIDsets are not particularly well-suited for the following:
  - Write-intensive applications
  - Database applications in which fields are continually updated
  - Transaction processing

Striped Mirrorset Planning Considerations

Striped mirrorsets (RAID 0+1) are a configuration of stripesets whose members are also mirrorsets (Figure 27). Consequently, this kind of storageset combines the performance of striping with the reliability of mirroring. The result is a storageset with very high I/O performance and high data availability. Figure 28 shows a second example of a striped mirrorset using six members.

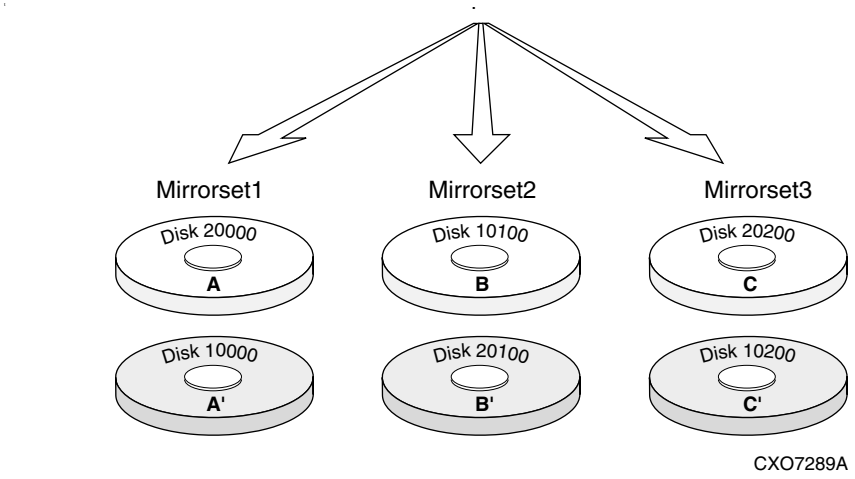


Figure 27: Striped mirrorset (example 1)

The failure of a single disk drive has no effect on the ability of the storageset to deliver data to the host. Under normal circumstances, a single disk drive failure has very little effect on performance. Because striped mirrorsets do not require any more disk drives than mirrorsets, this storageset is an excellent choice for data that warrants mirroring.

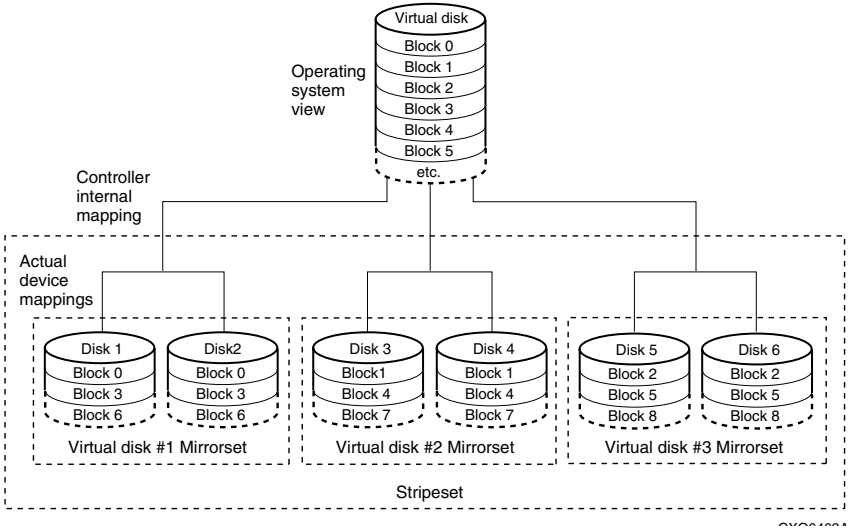


Figure 28: Striped mirrorset (example 2)

Plan the mirrorset members, and plan the stripeset that contains them. Review the recommendations in "Planning Considerations for Storageset", page 75, and "Mirrorset Planning Considerations", page 77.

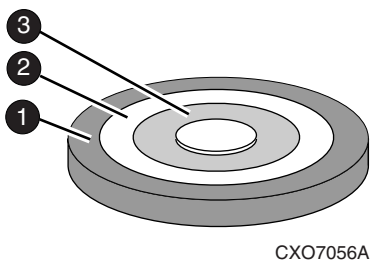
Storageset Expansion Considerations

Storageset Expansion allows for the joining of two of the same kind of storage containers by concatenating RAIDsets, stripesets, or individual disks, thereby forming a larger virtual disk which is presented as a single unit. The *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide* describes the CLI command, `ADD CONCATSETS`, which is used to perform concatenation.

Caution: Use the `ADD CONCATSETS` command only with host operating systems that support dynamic volume expansion. Use of this command could result in inacessible data, if the operating system cannot handle one of its disks increasing in size.

Partition Planning Considerations

Use partitions to divide a container (storageset or individual disk drive) into smaller pieces, each of which can be presented to the host as its own storage unit. Figure 29 shows the conceptual effects of partitioning a single-disk container.



❶ Partition 1
❷ Partition 2
❸ Partition 3

Figure 29: One example of a partitioned single-disk unit

You can create up to eight partitions per storageset (disk drive, RAIDset, mirrorset, stripeset, or striped mirrorset). Each partition has its own unit number so that the host can send I/O requests to the partition just as it would to any

unpartitioned storageset or device. Partitions are separately addressable storage units; therefore, you can partition a single storageset to service more than one user group or application.

Defining a Partition

Partitions are expressed as a percentage of the storageset or single disk unit that contains them:

- Mirrorsets and single disk units—the controller allocates the largest whole number of blocks that are equal to or less than the percentage you specify.
- RAIDsets and stripesets—the controller allocates the largest whole number of stripes that are less than or equal to the percentage you specify.
  - Stripesets—the stripe size = chunk size × number of members.
  - RAIDsets—the stripe size = chunk size × (number of members minus 1)

An unpartitioned storage unit has more capacity than a partition that uses the whole unit because each partition requires a small amount of disk space for metadata.

Guidelines for Partitioning Storagesets and Disk Drives

Keep these points in mind when planning partitions for storagesets and disks:

- Each storageset or disk drive may have up to eight partitions.
- In transparent failover mode, all partitions of a particular container must be on the same host port. Partitions cannot be split across host ports.
- In multiple-bus failover mode, all the partitions of a particular container must be on the same controller. Partitions cannot be split across controllers.
- Partitions cannot be combined into storagesets. For example, you cannot divide a disk drive into three partitions, then combine those partitions into a RAIDset.
- Just as with storagesets, you do not have to assign unit numbers to partitions until you are ready to use them.
- The Clone utility cannot be used with partitioned mirrorsets or partitioned stripesets. (See "Creating Clones for Backup", page 165, for details about cloning.)

Changing Characteristics Through Switches

CLI command switches allow you another level of command options. There are three types of switches that modify the storageset and unit characteristics:

- Storageset switches
- Initialization switches
- Unit switches

The following sections describe how to enable/modify switches. They also contain a description of the major CLI command switches.

Enabling Switches

If you use SWCC to configure the device or storageset, you can set switches from SWCC during the configuration process, and SWCC automatically applies them to the storageset or device. See the SWCC online help for information about using SWCC.

The configuration procedure found in Chapter 5 of this guide indicates when and how to enable each switch if you use CLI commands to configure the storageset or device manually. The *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide* contains the details of the CLI commands and their switches.

Changing Switches

You can change the RAIDset, mirrorset, device, and unit switches at any time. You cannot change the initialize switches without destroying data on the storageset or device. These switches are integral to the formatting and can only be changed by re-initializing the storageset.

Caution: Initializing a storageset is similar to formatting a disk drive; all data is destroyed during this procedure.

Specifying Storageset and Partition Switches

The characteristics of a particular storageset can be set by specifying switches when the storageset is added to the controllers' configuration. Once a storageset has been added, the switches can be changed by using a SET command. Switches can be set for partitions and the following types of storagesets:

- RAIDset
- Mirrorset

Stripesets have no specific switches associated with their ADD and SET commands.

RAIDset Switches

Use the following types of switches to control how a RAIDset ensures data availability:

- Replacement policy
- Reconstruction policy
- Remove/replace policy

For details on the use of these switches, refer to SET RAIDSET and SET *RAIDset-name* commands in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide.*

Mirrorset Switches

Use the following switches to control how a mirrorset behaves to ensure data availability:

- Replacement policy
- Copy speed
- Read source
- Membership

For details on the use of these switches, refer to ADD MIRRORSET and SET *mirrorset-name* commands in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide.*

Partition Switches

The following switches are available when creating a partition:

- Size
- Geometry

For details on the use of these switches, refer to CREATE_PARTITION command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide.*

Specifying Initialization Switches

Initialization switches set characteristics for established storagesets before they are made into units. The following kinds of switches effect the format of a disk drive or storageset:

- Chunk Size (for stripesets and RAIDsets only)
- Save Configuration
- Destroy/Nodestroy
- Geometry

Each of these switches is described in the following sections.

Note: After initializing the storageset or disk drive, you cannot change these switches without reinitializing the storageset or disk drive.

Chunk Size

With ACS software, a parameter for chunk size (chunksize=default or n) on some storagesets can be set. However, unit performance may be negatively impacted if a non-default value is selected as the chunksize.

If a non-default chunk size has been calculated, verify that the chunk size value is divisible by 8, with no remainder. If the value is not aligned with this rule, adjust the chunk size value upward until it divisible by 8, with no remainder.

Specify the chunk size of the data to be stored to control the stripesize used in RAIDsets and stripesets:

- CHUNKSIZE=DEFAULT lets the controller set the chunk size based on the number of disk drives (d) in a stripeset or RAIDset. If number of drives is less or equal to 9, then chunk size = 256. If the number of drives is greater than 9, then chunk size = 128.
- CHUNKSIZE=*n* lets you specify a chunk size in blocks. The relationship between chunk size and request size determines whether striping increases the request rate or the data-transfer rate.

Increasing the Request Rate

A large chunk size (relative to the average request size) increases the request rate by enabling multiple disk drives to respond to multiple requests. If one disk drive contains all of the data for one request, then the other disk drives in the storageset are available to handle other requests. Thus, separate I/O requests can be handled in parallel, which increases the request rate. This concept is shown in Figure 30.

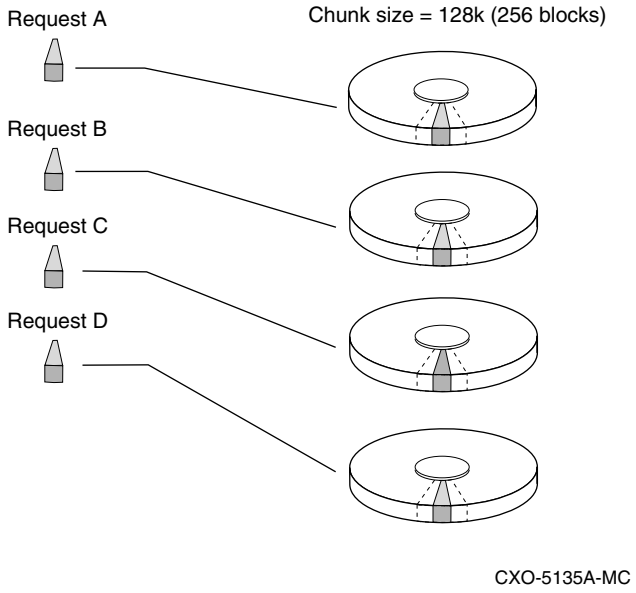


Figure 30: Large chunk size increases request rate

Large chunk sizes also tend to increase the performance of random reads and writes. HP recommends that you use a chunk size of 10 to 20 times the average request size, rounded to the closest prime number.

To calculate the chunk size that should be used for your subsystem, you must first analyze the types of requests that are being made to the subsystem:

- Many parallel I/Os that use a small area of disk should use a chunk size of 10 times the average transfer request rate.
- Random I/Os that are scattered over all the areas of the disks should use a chunk size of 20 times the average transfer request rate.
- If you do not know, use a chunk size of 15 times the average transfer request rate.

- If you have mostly sequential reads or writes (like those needed to work with large graphic files), make the chunk size for RAID 0 and RAID 0+1 a small number (for example: 67 sectors). For RAID 5, make the chunk size a relatively large number (for example: 253 sectors).

Table 10 shows a few examples of chunk size selection.

Table 10: Example chunk sizes

Transfer Size (KB)	Small Area of I/O Transfers	Unknown	Random Areas of I/O Transfers
2	41	59	79
4	79	113	163
8	157	239	317

Increasing Sequential Data Transfer Performance

RAID 0 and RAID 0+1 sets intended for high data transfer rates should use a relatively low chunk size (for example: 67 sectors). RAID 5 sets intended for high data rate performance should use a relatively large number (for example: 253 sectors).

Save Configuration

The SAVE_CONFIGURATION switch is for a *single-controller configuration only*. This switch reserves an area on each of the disks for the container being initialized. The controller can write subsystem configuration data on this area. If the controller is replaced, the new controller can read the subsystem configuration from the reserved areas of disks.

If you specify SAVE_CONFIGURATION for a multi-device storageset, such as a stripeset, the complete subsystem configuration is periodically written on each disk in the storageset.

The `SHOW DEVICES FULL` command shows which disks are used to backup configuration information.

Note: DO NOT use SAVE_CONFIGURATION in dual redundant controller installations. It is not supported and may result in unexpected controller behavior.

Note: HP recommends that you DO NOT use SAVE_CONFIGURATION on every unit and device on the controller.

Destroy/Nodestroy

Specify whether to destroy or retain your data and metadata when a disk is initialized after it has been used in a mirrorset or as a single-disk unit.

Note: The *DESTROY* and *NODESTROY* switches are only valid for mirrorsets and striped mirrorsets.

- DESTROY (default) overwrites your data and forced-error metadata when a disk drive is initialized.
- NODESTROY preserves your data and forced-error metadata when a disk drive is initialized. Use NODESTROY to create a single-disk unit from any disk drive that has been used as a member of a mirrorset. See the REDUCED command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide* for information on removing disk drives from a mirrorset.

  NODESTROY is ignored for members of a RAIDset.

Geometry

The geometry parameters of a storageset can be specified. The geometry switches are:

- CAPACITY—The number of logical blocks. The range is from 1 to the maximum container size.
- CYLINDERS—The number of cylinders used. The range is from 1 to 16777215.
- HEADS—The number of disk heads used. The range is from 1 to 255.
- SECTORS_PER_TRACK—The number of sectors per track used. The range is from 1 to 255.

Specifying Unit Switches

Several switches control the characteristics of units. The unit switches are described under the SET *unit-number* command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Command Line Interface Reference Guide*.

One unit switch, ENABLE/DISABLE_ACCESS_PATH, determines which host connections can access the unit, and it is described in the larger topic of matching units to specific hosts. This topic is covered in "Determining Connections", page 38.

Creating Storage Maps

Configuring a subsystem is easier if you know how the storagesets, partitions, and JBODs correspond to the disk drives in your subsystem. You can more easily see this relationship by creating a hardcopy representation, also known as a storage map.

To make a storage map, fill out the templates provided in Appendix A as you add storagesets, partitions, and JBOD disks to the configuration and assign them unit numbers. Label each disk drive in the map with the higher levels it is associated with, up to the unit level.

Using LOCATE Command to Find Devices

If you want to complete a storage map at a later time but do not remember where the disk drives and partitions are located, use the CLI command LOCATE. The LOCATE command flashes the (fault) LED on the drives associated with the specific storageset or unit. To turn off the flashing LEDs, enter the CLI command LOCATE CANCEL.

To locate all the disk drives that make up unit D104:

1. Enter the following command:

   ```
   LOCATE D104
   ```

   The LEDs on the disk drives that make up unit D104 flashes.
2. Note the position of all the drives contained within D104.
3. Enter the following command to turn off the flashing LEDs:

   ```
   LOCATE CANCEL
   ```

To locate all the drives that make up RAIDset R1:

1. Enter the following command:

   ```
   LOCATE R1
   ```
2. Note the position of all the drives contained within R1.
3. Enter the following command to turn off the flashing LEDs:

   ```
   LOCATE CANCEL
   ```

Example Storage Map–Model 4310R Disk Enclosure

Table 11 shows an example of four Model 4310R disk enclosures (single-bus I/O).

- Unit D100 is a 4-member RAID 3/5 storageset named R1. R1 consists of Disk10000, Disk20000, Disk30000, and Disk40000.
- Unit D101 is a 2-member striped mirrorset named S1. S1 consists of M1 and M2:
  - M1 is a 2-member mirrorset consisting of Disk10100 and Disk20100.
  - M2 is a 2-member mirrorset consisting of Disk30100 and Disk40100.
- Unit D102 is a 2-member mirrorset named M3. M3 consists of Disk10200 and Disk20200.
- Unit D103 is a 2-member mirrorset named M4. M4 consists of Disk30200 and Disk40200.
- Unit D104 is 3-member stripeset named S2. S2 consists of Disk10300, Disk20300, and Disk30300.
- Unit D105 is a single (JBOD) disk named Disk40300.
- Unit D106 is a 3-member RAID 3/5 storageset named R2. R2 consists of Disk10400, Disk20400, and Disk30400.
- Unit D107 is a single (JBOD) disk named Disk40400.
- Unit D108 is a 4-member stripeset named S3. S3 consists of Disk10500, Disk20500, Disk30500, and Disk40500.
- Unit D1 is a 2-member striped mirrorset named S4. S4 consists of M4 and M5:
  - M5 is a 2-member mirrorset consisting of Disk10800 and Disk20800.
  - M6 is a 2-member mirrorset consisting of Disk30800 and Disk40800.
- Unit D2 is a 4-member RAID 3/5 storageset named R3. R3 consists of Disk11000, Disk21000, Disk31000, and Disk41000.
- Unit D3 is a 4-member stripeset named S5. S5 consists of Disk11100, Disk21100, Disk31100, and Disk41100.
- Unit D4 is a 2-member mirrorset named M7. M7 consists of Disk11200 and Disk21200.
- Disk31200 and Disk41200 are spareset members.

Table 11: Model 4310R disk enclosure, example of storage map

Model 4310R Disk Enclosure Shelf 4 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	D100 R1 Disk40000	D101 S1 M2 Disk40100	D103 M4 Disk40200	D105 Disk40300	D107 Disk40400	D108 S3 Disk40500	D1 S4 M6 Disk40800	D2 R3 Disk41000	D3 S5 Disk41100	spare Disk41200
Model 4310R Disk Enclosure Shelf 1 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	D100 R1 Disk10000	D101 S1 M1 Disk10100	D102 M3 Disk10200	D104 S2 Disk10300	D106 R2 Disk10400	D108 S3 Disk10500	D1 S4 M5 Disk10800	D2 R3 Disk11000	D3 S5 Disk11100	D4 M7 Disk11200
Model 4310R Disk Enclosure Shelf 2 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	D100 R1 Disk20000	D101 S1 M1 Disk20100	D102 M3 Disk20200	D104 S2 Disk20300	D106 R2 Disk20400	D108 S3 Disk20500	D1 S4 M5 Disk20800	D2 R3 Disk21000	D3 S5 Disk21100	D4 M7 Disk21200

Model 4310R Disk Enclosure Shelf 3 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	D100 R1 Disk30000	D101 S1 M2 Disk30100	D103 M4 Disk30200	D104 S2 Disk30300	D106 R2 Disk30400	D108 S3 Disk30500	D1 S4 M6 Disk30800	D2 R3 Disk31000	D3 S5 Disk31100	spare Disk31200

Preparing the Host System

3

This chapter describes how to prepare your Linux host computer to accommodate the HSG80 controller storage subsystem.

The following information is included in this chapter:

Refer to Chapter 4 for instructions on how to install and configure the HSG Agent. The Agent for HSG is operating system-specific and polls the storage.

Installing RAID Array Storage System

WARNING: A shock hazard exists at the backplane when the controller enclosure bays or cache module bays are empty.

Be sure the enclosures are empty, then mount the enclosures into the rack. DO NOT use the disk enclosure handles to lift the enclosure. The handles cannot support the weight of the enclosure. Only use these handles to position the enclosure in the mounting brackets.

Use two people to lift, align, and install any enclosure into a rack. Failure to use two people might cause personal injury and/or equipment damage.

Caution: Controller and disk enclosures have no power switches. Make sure the controller enclosures and disk enclosures are physically configured before turning the PDU on and connecting the power cords. Failure to do so can cause equipment damage.

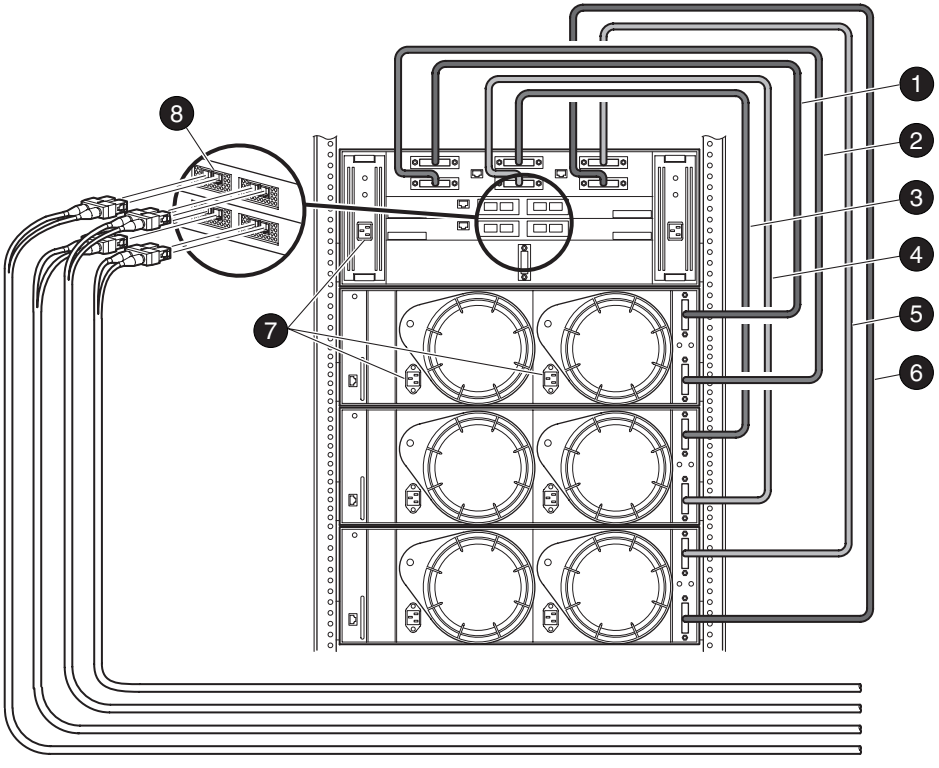
1. Be sure the enclosures are empty before mounting them into the rack. If necessary, remove the following elements from the controller enclosure:
   - Environmental Monitoring Unit (EMU)
   - Power Supplies
   - External Cache Batteries (ECBs)
   - Fans
2. If necessary, remove the following elements from the disk enclosure:
   - Power Supply/Blower Assemblies
   - Disk Drives
   - Environmental Monitoring Unit (EMU)
   - I/O Modules
3. Refer to the *HP StorageWorks Model 2100 and 2200 Ultra SCSI Controller Enclosures User Guide* and the *HP StorageWorks Model 4300 Family Ultra3 LVD Disk Enclosures User Guide* for further information.
4. Install brackets onto the controller enclosure and disk enclosures. Using two people, mount the enclosures into the rack. Refer to the mounting kit documentation for further information.

5. Install the elements. Install the disk drives. Make sure you install blank panels in any unused bays.

   Fibre Channel cabling information is shown to illustrate supported configurations. In a dual-bus disk enclosure configuration, disk enclosures 1, 2, and 3 are stacked below the controller enclosure—two SCSI Buses per enclosure (see Figure 31). In a single-bus disk enclosure configuration, disk enclosures 6, 5, and 4 are stacked above the controller enclosure and disk enclosures 1, 2, and 3 are stacked below the controller enclosure—one SCSI Bus per enclosure (see Figure 32).

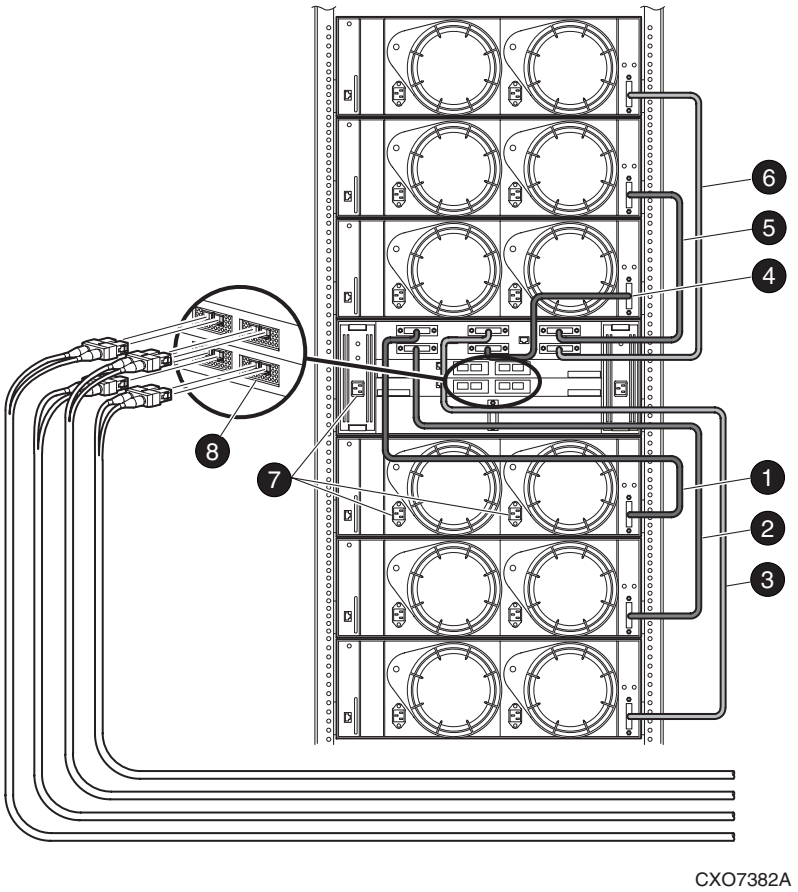
6. Connect the six VHDCI UltraSCSI bus cables between the controller and disk enclosures, as shown in Figure 31 for a dual-bus system and Figure 32 for a single-bus system. Note that the supported cable lengths are 1, 2, 3, 5, and 10 meters.

7. Connect the AC power cords from the appropriate rack AC outlets to the controller and disk enclosures.



❶ SCSI Bus 1 Cable
❷ SCSI Bus 2 Cable
❸ SCSI Bus 3 Cable
❹ SCSI Bus 4 Cable
❺ SCSI Bus 5 Cable
❻ SCSI Bus 6 Cable
❼ AC Power Inputs
❽ Fibre Channel Ports

Figure 31: Dual-bus enterprise storage RAID array storage system



❶ SCSI Bus 1 Cable
❷ SCSI Bus 2 Cable
❸ SCSI Bus 3 Cable
❹ SCSI Bus 4 Cable
❺ SCSI Bus 5 Cable
❻ SCSI Bus 6 Cable
❼ AC Power Inputs
❽ Fibre Channel Ports

Figure 32: Single-bus enterprise storage RAID array storage system

Making a Physical Connection

To attach a host computer to the storage subsystem, install one or more host bus adapters into the computer. A Fibre Channel (FC) cable goes from the host bus adapter to an FC switch.

Preparing to Install Host Bus Adapter

Before installing the host bus adapter, perform the following steps:

1. Perform a complete backup of the entire system.
2. Shut down the computer system or perform a hot addition of the adapter based upon directions for that server.

Installing Host Bus Adapter

To make a physical connection, first install a host bus adapter.

Caution: Protect the host bus adapter board from electrostatic discharge by wearing an ESD wrist strap. DO NOT remove the board from the antistatic cover until you are ready to install it.

You need the following items to begin:

- Host bus adapter board
- The computer hardware manual
- Appropriate tools to service your computer

The host bus adapter board plugs into a standard PCI slot in the host computer. Refer to the system manual for instructions on installing PCI devices.

Note: Take note of the worldwide name (WWN) of each adapter. Do not power on anything yet. For the FC switches to autoconfigure, power on equipment in a certain sequence. Also, the controllers in the subsystem are not yet configured for compatibility with Linux.

The StorageWorks Solutions Software consists of the packages as shown in Table 12.

Table 12: StorageWorks Solution Software Packages

Package	Description
CPQraidsw	Agent software and system updates required for RAID system operation. This package should always be installed.
CPQqla2x00	HBA driver for the CPQ/Qlogic QLA2200 Fibre Channel 64-bit PCI This package needs to be loaded to use the QLA2200 HBA.
CPQInstall	The installation scripts package.

Installing Solution Software Packages

This section includes the following topic:

Installing the Solution Software Kit

Perform the following steps to install the Solution Software:

1. Extract the files from the compressed tarball. The archive is a zipped tarball so you will need to use `gunzip` and `tar` to extract the files.

   The files will extract to a directory called `hsg80_v88`.
2. Change the directory to the new `hsg80_v88` directory that was extracted.
3. Execute the `install_stgwks.v88` script by typing:

   ```
   # ./install_stgwks.v88
   ```

   This will install the `hp_qla2x00src`, `fibreutils`, and `HPraidsw` RPMs.

To install the kit components manually:

1. Change the directory to the `hsg80_v88/RPMS` directory.
2. Use the following commands to install each of the kit components:

   ```
   # rpm -Uvh hp_qla2x00src-<version>.noarch.rpm
   # rpm -ivh fibreutils-<version>.i386.rpm
   # rpm -ivh Hpraidsw-2.5.rpm
   ```

Upgrading or Uninstalling Solution Kit Software

To upgrade from a previous version of your Solution Software:

1. Uninstall Secure Path if installed. Failing to do so could cause a kernel panic.
2. Run the `install_stgwks.v88` script to upgrade the Solution Software.
3. Reinstall Secure Path.

To uninstall the Solution Software, execute the `install_stgwks.v88` script with the -u option by typing:

```
# ./install_stgwks.v88 -u
```

To manually uninstall the kit components, execute the following commands:

```
# rpm -e HPraidsw
# rpm -e fibreutils
# rpm -e hp_qla2x00src
```

Solution Software Upgrade Procedures

Use the following procedures for upgrades to your Solution Software. It is considered best practice to follow this order of procedures:

1. Perform backups of data prior to upgrade.
2. Verify operating system versions, upgrade operating systems to supported versions and patch levels.
3. Quiesce all I/O and unmount all file systems before proceeding.
4. Upgrade switch firmware.
5. If installing an operating system that uses Secure Path, upgrade Secure Path to the latest version which will also upgrade Solution Software, then skip to step 7.
6. Upgrade Solution Software.
7. Upgrade ACS software.

Note: Solely for the purpose of performing upgrades to the ACS firmware, this Solution Software Kit supports previous ACS V8.6 and 8.7. It is recommended that you do not mix ACS versions in the same SAN.

Refer to the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Maintenance and Service Guide* and the *Solution Software Release Notes* for the latest information on upgrades.

Preparing LUNs for Use by the File System

Each logical unit number (LUN) created on the Enterprise Storage RAID Array appears as a SCSI hard disk to the host. Therefore, it must be labeled before it can be used and, in most instances, a new file system must be created.

Labeling LUNs

A LUN is labeled using the fdisk utility. The label contains information about the LUN such as controller-type, geometry, and partitions. More details about the use of the fdisk utility may be found in the `fdisk` man page.

Creating and Tuning File Systems

Before the new LUN can be used by the system, a new file system must be created on each partition that is mounted. Use the mkfs command to create file systems. For more information, refer to the online Help for the mkfs commands. To create a new file system, use the following command:

```
# mkfs /dev/sdk2
```

Installing and Configuring HSG Agent

4

StorageWorks Command Console (SWCC) enables real-time configuration of the storage environment and permits you to monitor and configure the storage connected to the HSG80 controller.

The following information is included in this chapter:

Refer to Chapter 5 for a description of how to configure a subsystem that uses Fibre Channel fabric topology.

Why Use StorageWorks Command Console (SWCC)?

StorageWorks Command Console (SWCC) enables you to monitor and configure the storage connected to the HSG80 controller. SWCC consists of Client and Agent.

- The Client provides pager notification and lets you manage your virtual disks. The Client runs on Windows 2000 with Service Pack 4, Windows NT 4.0 with Service Pack 6A or above, and Windows Server 2003 (32-bit).
- The Agent obtains the status of the storage connected to the controller. It also passes the status of the devices connected to the controller to other computers and provides email notification and error logging.

To receive information about the devices connected to your HSG80 controller over a TCP/IP network, you must install the Agent on a computer that is connected to a controller.

The Agent can also be used as a standalone application without Client. In this mode, which is referred to as Agent only, Agent monitors the status of the subsystem and provides local and remote notification in the event of a failure. A subsystem includes the HSG80 controller and its devices. Remote and local notification can be made by email, System Error Log and/or SNMP messages to an SNMP monitoring program.

Table 13: SWCC features and components

Features	Agent Required?	Client Required?
Creation of RAID sets: Striped device group (RAID 0) Mirrored device group (RAID 1) Striped mirrored device group (RAID 0+1) Striped parity device group (RAID 3/5) Individual device (JBOD)	Yes	Yes
Monitor multiple subsystems at once	Yes	No
Event logging	Yes	No
Email notification	Yes	No
Pager notification	Yes	Yes

Note: For serial and SCSI connections, the Agent is not required for creating virtual disks.

Installation and Configuration Overview

Table 14 provides an overview of the installation.

Table 14: Installation and configuration overview

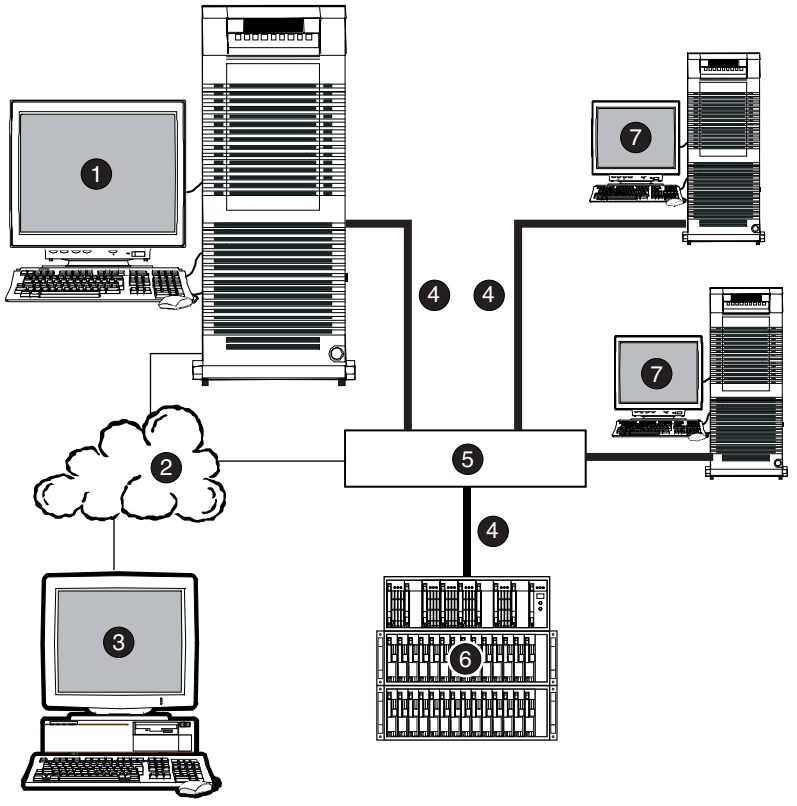
Step	Procedure
1	Verify that your hardware has been set up correctly. See the previous chapters in this guide.
2	Verify that you have a network connection for the Client and Agent systems. See "About the Network Connection for the Agent", page 111.
3	Verify that there is a LUN for communications. This can be either the CCL or a LUN that was created with the CLI. See "What is the Command Console LUN?", page 36, in Chapter 1.
4	Install the Agent (TCP/IP network connections) on a system connected to the HSG80 controller.
5	Add the name of the Client system to the Agent's list of Client system entries (TCP/IP network connections). This can be done during installation or when reconfiguring the Agent.
6	Install the Client software on Windows 2000 with Service Pack 4 or Windows NT 4.0 with Service Pack 6A, and Windows Server 2003 (32-bit). See Appendix B.
7	Add the name of the Agent system to the Navigation Tree of each Client system that is on the Agent's list of Client system entries (TCP/IP network connections). See Appendix B.
8	Set up pager notification (TCP/IP network connections). Refer to "Setting Up Pager Notification" in the *HP StorageWorks Command Console V2.5 User Guide.*

About the Network Connection for the Agent

The network connection, shown in Figure 33, displays the subsystem connected to a hub or a switch. SWCC can consist of any number of Clients and Agents in a network. However, it is suggested that you install only one Agent on a computer.

By using a network connection, you can configure and monitor the subsystem from anywhere on the LAN. If you have a WAN or a connection to the Internet, monitor the subsystem with TCP/IP.

Note: SWCC does not support the dynamic host configuration protocol (DHCP) or the Windows Internet Name Service (WINS).



❶ Agent system (has the Agent software)

❷ TCP/IP network

❸ Client system (has the Client software)

❹ Fibre Channel cable

❺ Hub or switch

❻ HSG80 controller and its device subsystem

❼ Servers

Figure 33: An example of a network connection

Mapping SCSI-generic Devices

A SCSI-generic device must be created for communication between the SWCC Agent and the HSG80 RAID Controller. This prevents conflicts between the SCSI disk driver (which presents blocked (filesystem-oriented) devices to the system), and the SWCC Agent (which requires the capability to perform raw I/O operations),

SCSI-generic devices can be created using the `MAKEDEV` script in the /DEV directory.

- If you have *fewer* than 26 sd devices configured on your system, you can execute the following commands:

  ```
  # cd /dev
  # ./makedev sg
  ```

- If you have *more* than 26 sd devices configured on your system, you can specify the particular sg device that you want to create by using the following commands:

  ```
  # cd /dev
  # /makedev sgk
  ```

  The `MAKEDEV` script has been patched to ensure that the above procedure works for up to 256 sg devices.

Sg devices follow the same type of nomenclature convention as sd devices with one exception. Under the SCSI-3 configuration that you use on the HSG80 RAID Controller, the Command Console LUN is reported as a device type 12 (RAID Controller). Device type 12 cannot be mapped to an sd device, but is mapped to an sg device; this mapping process causes the range of sd devices to skip over the HSG80 CCL. Use the scsi_info command to determine where there is a break in the list of sd devices, so that you can successfully map an sg device.

For example:

The first HSG80 sd device on your system is `/dev/sdk`, which you determined by using `scsi_info` on your sd devices. The output for `scsi_info /dev/sdk` looks as follows:

```
SCSI_ID="0,0,1"
MODEL="DEC HSG80"
FW_REV="V86"
```

Your Command Console LUN for this controller has a SCSI ID of “0,0,0”. After performing a `/dev/MAKEDEV sgk` command, you receive the following output from the command `scsi_info /dev/sgk`:

```
SCSI_ID=”0,0,0”
MODEL=”DEC HSGCCL”
FW_REV=”V86”
```

Note: At this point the sd device sdk maps to the sg device sgl.

Configuring the Agent

SWadmin (`config.sh`) is a menu-based administration tool that is usually used to modify your Agent configuration after installation. It provides more options than `install.sh`, so it is recommended for advanced users or users with unique configuration needs. It can also be used for first-time configuration. See "Configuring the Agent with RAID Array V8.8-1 Configuration Maneuver" instructions on running Config.sh.

Configuring the Agent with RAID Array V8.8-1 Configuration Menu

To view the RAID Array V8.8-1 Configuration Menu, run the `Config.sh` script from the `$basedir/steam/bin` directory (usually `/usr/local/steam/bin`).

1. Enter the following command:

   ```
   # cd /usr/local/steam/bin
   ```

2. Enter the following command:

   ```
   #./config.sh
   ```

   The Configuration Menu shown in Figure 34 opens.

```
----  RAID Array 2.3 Configuration Menu ----

Agent Admin:                              Client:
------------                              -------
1) Change the Agent password              6) Add a Client
2) Change SNMP Enterprise OID             7) Remove a Client
3) Start/Stop the Agent                   8) Modify a Client
4) Toggle Agent startup on system boot    9) View Clients
5) Uninstall the Agent (Platform Kit)

Agent Notification:                       Storage Subsystem:
-------------------                       ------------------
14) Enable/Disable syslog notification    10) Add a subsystem
15) Add user to mail notification list    11) Remove a subsystem
16) Delete user from mail notific. list   12) Modify a subsystem
17) Modify mail notification list         13) View subsystems
18) View mail notification list           20) RAID Config
19) Enable/Disable mail notification      21) LUN Scanning

 Q) Quit
```

Figure 34: SWadmin tool for configuring LUNs and SWCC Agent

Note: When you change the Agent configuration, you must restart the Agent for your changes to take effect.

Choosing a Password

Select **option 1** from the Agent Admin Options group to set a password to protect your subsystems from unauthorized access. Any Client with configuration privileges is asked for this password when attempting to configure the subsystem.

Adding a Subsystem Entry

Any storageset belonging to the subsystem can be used for this procedure, but do not delete the LUN from the subsystem when reconfiguring, as this breaks the communication link to the Agent for the entire subsystem.

1. From the Storage Subsystem Options group, select **13,** to View Subsystems. An empty table opens.
2. Choose **10**, to add a subsystem. Before starting the Agent, you must add at least one subsystem with which you wish to communicate.
3. Enter a subsystem name. The subsystem name is arbitrary, but use only lowercase characters to specify it.
4. Associate the subsystem name with a storage subsystem by picking a LUN name. The LUN name must be a SCSI-generic (sg) device, which maps to the HSG80 Command Console LUN. See "Mapping SCSI-generic Devices", page 113, for more information on sg devices.
5. Enter a monitoring interval; for example, 30 0 seconds.
6. Press the **Enter** key twice to return to the **Main Menu**.

Adding a Client System Entry

To add a Client system entry, perform the following procedure, starting at the **Configuration Menu**.

1. From the **Client Options** group, select **9** (**View Clients**) to see the authorized Client list.
2. To add a Client, select **6** (**Add Client**).
3. Enter the Client's network name (for example, myhost).

4. Enter an Access level code. Specify 2 if the manager/Client is allowed to configure the subsystem.
5. Add an Error Notification Level (1 for TCP sockets, 2 for SNMP protocol, or 3 for both).

Restarting the SWCC Agent

After you make any changes to the SWCC Agent configuration, the SWCC Agent daemon must be stopped and restarted. This ensures that the changes to the configuration files are read by the `steamd` program.

RAID Manager Email Messages

Email messages sent by the RAID Manager are useful in troubleshooting subsystem problems. To receive RAID Manager messages, you must enable "email notification" within the Agent Configuration program. For more information on how to decipher email messages from RAID Manager, refer to the *HP StorageWorks Command Console V2.5 User Guide*.

FC Configuration Procedures

5

This chapter describes procedures to configure a subsystem that uses Fibre Channel (FC) fabric topology. In fabric topology, the controller connects to its hosts through switches.

The following information is included in this chapter:

Use the command line interpreter (CLI) or StorageWorks Command Console (SWCC) to configure the subsystem. This chapter uses CLI to connect to the controller. To use SWCC for configuration, see the SWCC online help for assistance.

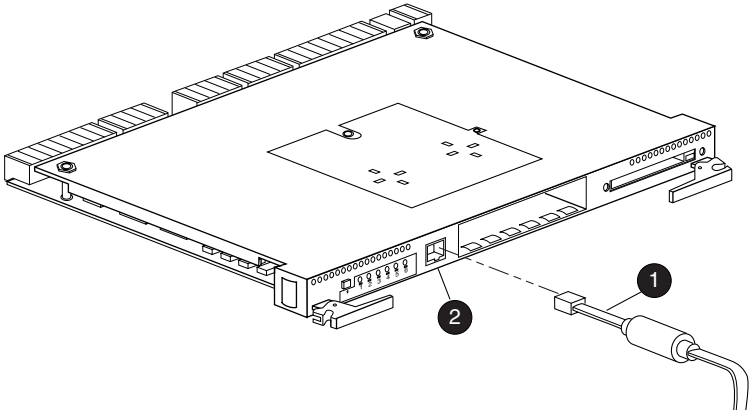
Note: These configuration procedures assume that controllers and cache modules are installed in a fully functional and populated enclosure and that the PCMCIA cards are installed.

To install a controller or cache module and the PCMCIA card, see the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Maintenance and Service Guide*.

Establishing a Local Connection

A local connection is required to configure the controller until a command console LUN (CCL) is established using the CLI. Communication with the controller can be through the CLI or SWCC.

The maintenance port, shown in Figure 35, provides a way to connect a maintenance port. The maintenance port can be an EIA-423 compatible terminal or a computer running a terminal emulator program. The maintenance port accepts a standard RS-232 jack. The maintenance port cable shown in Figure 35 has a 9-pin connector molded onto the end for a PC connection. If you need a terminal connection or a 25-pin connection, you can order optional cabling.



❶ Maintenance Port Cable

❷ Maintenance Port

Figure 35: Maintenance port connection

Caution: The maintenance port generates, uses, and can radiate radio-frequency energy through its cables. This energy may interfere with radio and television reception. Disconnect all maintenance port cables when not communicating with the controller through the local connection.

Establishing Connection with a Linux System

Note: The following examples use the Linux `cu` utility which can be found in the UUCP package.

To set up your Linux system for connection with the HSG80 Controller, follow these steps:

1. Use the supplied serial cable and the 9 to 25 pin RS-232 adapter (P/N=12-45238-01) to connect the serial port on the Linux system to the serial port on the RAID array controller.
2. Open the file `/etc/uucp/port`.
3. Verify the following lines exist in the `port` file:

   ```
   port com1
   type direct
   device /dev/ttyS0
   speed 9600
   ```

   If these lines are not in the `port` file for the appropriate serial port, enter them and save the file.
4. Create `/dev/ttys0` by entering:

   ```
   cd /dev
   ./MAKEDEV ttyS0
   ```
5. Open a terminal window from the **Desktop Program** menu.
6. Start the Call Up (CU) Program, at the prompt type:

   ```
   cu -p com1
   ```

   Press **Enter**.
7. Press **Enter** again, and the CLI prompt is displayed, similar to the following:

   ```
   HSG80>
   ```

Setting Up a Single Controller

Powering On and Establishing Communication

1. Connect the computer or terminal to the controller, as shown in Figure 35. The connection to the computer is through the COM1 or COM2 port.
2. Turn on the computer or terminal.
3. Apply power to the storage subsystem.
4. Open the file `/etc/uucp/port`.
5. Verify that the computer or terminal is configured as follows as shown in the `port` file:
   - 9600 baud
   - 8 data bits
   - 1 stop bit
   - no parity
   - no flow control

   If these lines are not in the `port` file for the appropriate serial port, enter them and save the file.
6. Create */dev/ttys0* by entering the following commands:

   ```
   cd /dev
   ./MAKEDEV ttyS0
   ```
7. Open a terminal window from the **Desktop Program** menu.
8. Start the Call Up (CU) Program, by entering the following command at the prompt:

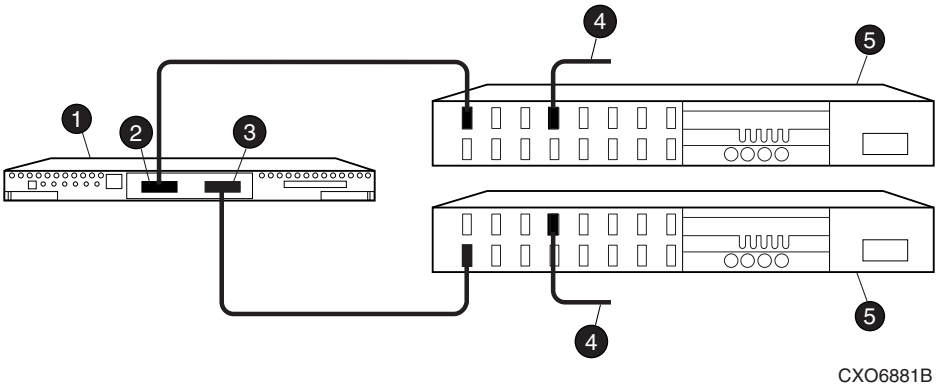
   ```
   cu -p com1
   ```
9. Press **Enter**. A copyright notice and the CLI prompt is displayed, indicating that you established a local connection with the controller.

Note: This example uses the Linux Call Up (CU) program which can be found in the UUCP package.

Cabling a Single Controller

The cabling for a single controller is shown in Figure 36.

Note: It is a good idea to plug only the controller cables into the switch. The host cables are plugged into the switch as part of the configuration procedure ("Configuring a Single Controller Using CLI", page 123).



❶ Controller
❷ Host port 1
❸ Host port 2
❹ Cable from the switch to the host Fibre Channel adapter
❺ FC switch

Figure 36: Single controller cabling

Configuring a Single Controller Using CLI

To configure a single controller using CLI involves the following processes:

- "Verifying the Node ID and Check for Any Previous Connections", page 124
- "Configuring Controller Settings", page 125
- "Restarting the Controller", page 125
- "Setting Time and Verifying All Commands", page 125
- "Plugging in the FC Cable and Verifying Connections", page 128
- "Repeating Procedure for Each Host Adapter", page 128

- "Verifying Installation", page 128

Verifying the Node ID and Check for Any Previous Connections

1. Enter a SHOW THIS command to verify the node ID:

   ```
   SHOW THIS
   ```

   See "Worldwide Names (Node IDs and Port IDs)", page 52, for the location of the sticker.

   The node ID is located in the third line of the SHOW THIS result:

   ```
   HSG80> SHOW THIS
   Controller:
      HSG80 ZG80900583 Software V8.8, Hardware E11
      NODE_ID          = 5000-1FE1-0001-3F00
      ALLOCATION_CLASS = 0
   ```

   If the node ID is present, go to step 5.
   If the node ID is all zeroes, enter node ID and checksum, which are located on a sticker on the controller enclosure. Use the following syntax to enter the node ID:

   ```
   SET THIS NODE_ID=NNNN-NNNN-NNNN-NNNN nn
   ```

   Where:*NNNN-NNNN-NNNN-NNNN* is the node ID, and *nn* is the checksum.

2. When using a controller that is not new from the factory, enter the following command to take it out of any failover mode that may have been configured previously:

   ```
   SET NOFAILOVER
   ```

   If the controller did have a failover mode previously set, the CLI may report an error. Clear the error with this command:

   ```
   CLEAR_ERRORS CLI
   ```

3. Enter the following command to remove any previously configured connections:

   ```
   SHOW CONNECTIONS
   ```

   A list of named connections, if any, opens.

4. Delete these connections by entering the following command:

   ```
   DELETE !NEWCON01
   ```

Repeat the Delete command for each of the listed connections. When completed, no connection opens.

Configuring Controller Settings

5. Set the SCSI version using the following command syntax:

```
SET THIS SCSI_VERSION=SCSI-3
```

6. Assign an identifier for the communication LUN (also called the command console LUN, or CCL). The CCL must have a unique identifier that is a decimal number in the range 1 to 32767, and which is different from the identifiers of all units. Use the following syntax:

```
SET THIS IDENTIFIER=N
```

Identifier must be unique among all the controllers attached to the fabric within the specified allocation class.

7. Set the topology for the controller. If both ports are used, set topology for both ports:

```
SET THIS PORT_1_TOPOLOGY=FABRIC
SET THIS PORT_2_TOPOLOGY=FABRIC
```

If the controller is not factory-new, it may have another topology set, in which case these commands results in an error message. If this happens, take both ports offline first, then reset the topology:

```
SET THIS PORT_1_TOPOLOGY=OFFLINE
SET THIS PORT_2_TOPOLOGY=OFFLINE
SET THIS PORT_1_TOPOLOGY=FABRIC
SET THIS PORT_2_TOPOLOGY=FABRIC
```

Restarting the Controller

8. Restart the controller, using the following command:

```
RESTART THIS
```

Setting Time and Verifying All Commands

1. Set the time on the controller by entering the following syntax:

```
SET THIS TIME=DD-MMM-YYYY:HH:MM:SS
```

2. Use the FRUTIL utility to set up the battery discharge timer. Enter the following command to start FRUTIL:

   ```
   RUN FRUTIL
   ```

   When FRUTIL asks if you intend to replace the battery, answer **Y**:

   ```
   Do you intend to replace this controller's cache battery? Y/N
   [N] Y
   ```

   FRUTIL prints out a procedure, but does not give you a prompt. Ignore the procedure and press the **Enter** key.

3. Set up any additional optional controller settings, such as changing the CLI prompt. See the SET *THIS CONTROLLER/OTHER CONTROLLER* command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide* for the format of optional settings.

4. Verify that all commands have taken effect. Use the following command:

   ```
   SHOW THIS
   ```

   Verify node ID, allocation class, SCSI version, failover mode, identifier, and port topology.

The following sample is a result of a SHOW THIS command, with the areas of interest in bold.

```
Controller:
   HSG80 ZG94214134 Software V8.8, Hardware 0000
   NODE_ID          = 5000-1FE1-0007-9750
   ALLOCATION_CLASS = 0
   SCSI_VERSION     = SCSI-3
    Configured for dual-redundancy with ZG9421461
   In dual-redundant configuration
Device Port SCSI address 7
   Time: 10-Mar-2002:12:30:34
   Command Console LUN is disabled
    Smart Error Eject Disabled
Host PORT_1:
   Reported PORT_ID = 5000-1FE1-0007-9751
    PORT_1_TOPOLOGY = FABRIC (fabric up)
   Address          = 7D4000
Host PORT_2:
   Reported PORT_ID = 5000-1FE1-0007-9752
    PORT_2_TOPOLOGY = FABRIC (standby)
   Address          = 210513
NOREMOTE_COPY
Cache:
    512 megabyte write cache, version 0022
   Cache is GOOD
    No unflushed data in cache
    CACHE_FLUSH_TIMER = DEFAULT (10 seconds)
Mirrored Cache:
    Not enabled
Battery:
    NOUPS
    FULLY CHARGED
    Expires: 25-JUN-2003
.......
```

5. Turn on the switches, if not done previously.

   If you want to communicate with the Fibre Channel switches through Telnet, set an IP address for each switch. See the manuals that came with the switches for details.

Plugging in the FC Cable and Verifying Connections

6. Plug the Fibre Channel cable from the first host bus adapter into the switch. Enter the SHOW CONNECTIONS command to view the connection table:

   ```
   SHOW CONNECTIONS
   ```

7. Rename the connections to something meaningful to the system and easy to remember. For example, to assign the name ANGEL1A1 to connection !NEWCON01, enter:

   ```
   RENAME !NEWCON01 ANGEL1A1
   ```

   For a recommended naming convention, see "Naming Connections", page 39.

8. Specify the operating system for the connection:

   ```
   SET ANGEL1A1 OPERATING_SYSTEM=SUN
   ```

Note: No Linux connection exists at this time. You must use the **SUN** setting, as the connections for SCSI match closely.

---

9. Verify the changes:

   ```
   SHOW CONNECTIONS
   ```

   Mark or tag all Fibre Channel cables at both ends for ease of maintenance.

Repeating Procedure for Each Host Adapter

10. Repeat step 7, 8, and 9 for each of that adapter's host connections, or delete the unused connections from the table.
11. For each host adapter, repeat steps 6 through 10.

Verifying Installation

To verify installation for your Linux host, restart your system with the `-r` option (restart). After the system is booted, use the `SCSI_info` command to verify that your LUNs are accessible.

After the system is booted, use the `SCSI_info` command to verify that your LUNs are accessible.

Setting Up a Controller Pair

The following procedures describe how to set up a controller pair.

Powering Up and Establishing Communication

1. Connect the computer or terminal to the controller as shown in Figure 35. The connection to the computer is through the COM1 or COM2 ports.
2. Turn on the computer or terminal.
3. Apply power to the storage subsystem.
4. Open the file `/etc/uucp/port`
5. Configure the computer or terminal as follows:
   - 9600 baud
   - 8 data bits
   - 1 stop bit
   - no parity
   - no flow control

   If these lines are not in the port file for the appropriate serial port, enter them and save the file.
6. Create /DEV/*ttys0* by entering the following command:

   ```
   cd /dev
   ./MAKEDEV ttyS0
   ```
7. Open a terminal window from the Desktop Program menu.
8. Start the Call Up Program (CU) by entering the following command:

   ```
   cu -p com1
   ```
9. Press **Enter**.

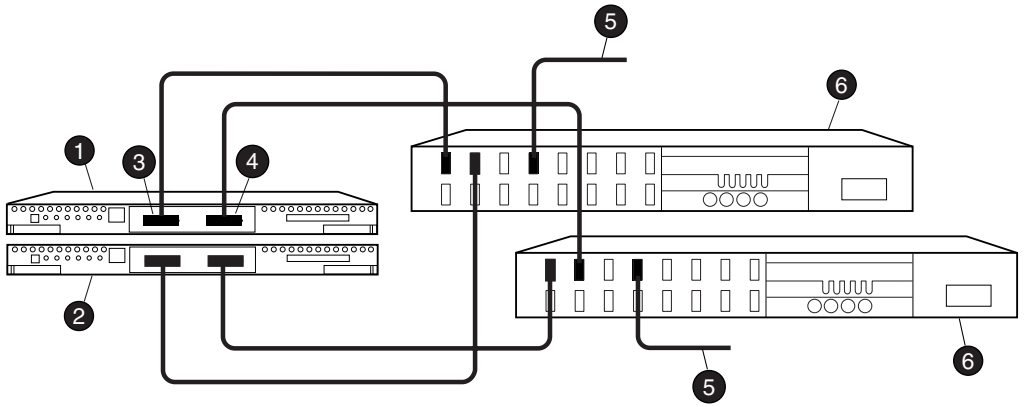
A copyright notice and the CLI prompt is displayed, indicating that you established a local connection with the controller.

Cabling a Controller Pair

The cabling for a controller pair is shown in Figure 37.

Note: It is a good idea to plug only the controller cables into the switch. The host cables are plugged into the switch as part of the configuration procedure ("Configuring a Controller Pair Using CLI", page 131).

Figure 37 shows a controller pair with failover cabling showing one HBA per server with HSG80 controller in transparent failover mode.



❶ Controller A
❷ Controller B
❸ Host port 1
❹ Host port 2
❺ Cable from the switch to the host FC adapter
❻ FC switch

Figure 37: Controller pair failover cabling

Configuring a Controller Pair Using CLI

To configure a controller pair using CLI involves the following processes:

- "Configuring Controller Settings", page 133
- "Restarting the Controller", page 133
- "Setting Time and Verifying All Commands", page 133
- "Plugging in the FC Cable and Verifying Connections", page 136

- "Verifying Installation", page 137

1. Enter a SHOW THIS command to verify the node ID:

   ```
   SHOW THIS
   ```

   See "Worldwide Names (Node IDs and Port IDs)", page 52, for the location of the sticker.

   The node ID is located in the third line of the SHOW THIS result:

   ```
   HSG80> show this
   Controller:
      HSG80 ZG80900583 Software V8.8, Hardware E11
      NODE_ID           = 5000-1FE1-0001-3F00
      ALLOCATION_CLASS = 0
   ```

   If the node ID is present, go to step 5.
   If the node ID is all zeroes, enter the node ID and checksum, which are located on a sticker on the controller enclosure. Use the following syntax to enter the node ID:

   ```
   SET THIS NODE_ID=NNNN-NNNN-NNNN-NNNN nn
   ```

   Where: *NNNN-NNNN-NNNN-NNNN* is the node ID and *nn* is the checksum.

2. If the controller is not new from the factory, enter the following command to take it out of any failover mode that may have been previously configured:

   ```
   SET NOFAILOVER
   ```

   If the controller did have a failover mode previously set, the CLI may report an error. Clear the error with this command:

   ```
   CLEAR_ERRORS CLI
   ```

3. Enter the following command to remove any previously configured connections:

   ```
   SHOW CONNECTIONS
   ```

   A list of named connections, if any, opens.

4. Delete these connections by entering the following command:

   ```
   DELETE !NEWCON01
   ```

   Repeat the Delete command for each of the listed connections. When completed, no connection opens.

Configuring Controller Settings

5. Set the SCSI version to SCSI-3 using the following command:

   ```
   SET THIS SCSI_VERSION=SCSI-3
   ```

6. Set the topology for the controller. If both ports are used, set topology for both ports:

   ```
   SET THIS PORT_1_TOPOLOGY=FABRIC
   SET THIS PORT_2_TOPOLOGY=FABRIC
   ```

   If the controller is not factory-new, it may have another topology set, in which case these commands result in an error message. If this happens, first take both ports offline, then reset the topology:

   ```
   SET THIS PORT_1_TOPOLOGY=OFFLINE
   SET THIS PORT_2_TOPOLOGY=OFFLINE
   SET THIS PORT_1_TOPOLOGY=FABRIC
   SET THIS PORT_2_TOPOLOGY=FABRIC
   ```

Restarting the Controller

7. Restart the controller, using the following command:

   ```
   RESTART THIS
   ```

   It takes about a minute for the CLI prompt to come back after a RESTART command.

Setting Time and Verifying All Commands

8. Set the time on the controller by entering the following syntax:

   ```
   SET THIS TIME=DD-MMM-YYYY:HH:MM:SS
   ```

9. Use the FRUTIL utility to set up the battery discharge timer. Enter the following command to start FRUTIL:

   ```
   RUN FRUTIL
   ```

   When FRUTIL asks if you intend to replace the battery, answer **Y**:

   ```
   Do you intend to replace this controller's cache battery? Y/N
   [N] Y
   ```

   FRUTIL prints out a procedure, but does not give you a prompt. Ignore the procedure and press **Enter**.

10. Set up any additional optional controller settings, such as changing the CLI prompt. See the SET *THIS CONTROLLER/OTHER CONTROLLER* command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide* for the format of optional settings. Perform this step on both controllers.
11. Verify that all commands have taken effect by entering the following command:

    ```
    SHOW THIS
    ```

12. Verify node ID, allocation class, SCSI version, failover mode, identifier, and port topology. The following display is a sample result of a SHOW THIS command, with the areas of interest in bold.

```
Controller:
   HSG80 ZG94214134 Software V8.8, Hardware 0000
   NODE_ID          = 5000-1FE1-0007-9750
   ALLOCATION_CLASS = 0
   SCSI_VERSION     = SCSI-3
    Configured for dual-redundancy with ZG9421461
   In dual-redundant configuration
Device Port SCSI address 7
   Time: 10-Mar-2002:12:30:34
   Command Console LUN is disabled
    Smart Error Eject Disabled
Host PORT_1:
   Reported PORT_ID = 5000-1FE1-0007-9751
    PORT_1_TOPOLOGY = FABRIC (fabric up)
   Address          = 7D4000
Host PORT_2:
   Reported PORT_ID = 5000-1FE1-0007-9752
    PORT_2_TOPOLOGY = FABRIC (standby)
   Address          = 210513
NOREMOTE_COPY
Cache:
    512 megabyte write cache, version 0022
   Cache is GOOD
    No unflushed data in cache
    CACHE_FLUSH_TIMER = DEFAULT (10 seconds)
Mirrored Cache:
    Not enabled
Battery:
    NOUPS
    FULLY CHARGED
    Expires: 25-JUN-2003
```

13. Turn on the switches if not done previously.

    If you want to communicate with the FC switches through Telnet, set an IP address for each switch. See the manuals that came with the switches for details.

Plugging in the FC Cable and Verifying Connections

14. Plug the FC cable from the first host adapter into the switch. Enter a SHOW CONNECTIONS command to view the connection table:

    ```
    SHOW CONNECTIONS
    ```

    The first connection has one or more entries in the connection table. Each connection has a default name of the form !NEWCON*xx*, where *xx* is a number representing the order in which the connection was added to the connection table.

    For a description of why plugging in one adapter can result in multiple connections, see "Numbers of Connections", page 39.

15. Rename the connections to something meaningful to the system and easy to remember. For example, to assign the name ANGEL1A1 to connection !NEWCON01, enter:

    ```
    RENAME !NEWCON01 ANGEL1A1
    ```

    HP recommends using a naming convention, see "Naming Connections", page 39.

16. Specify the operating system for the connection:

    ```
    SET ANGEL1A1 OPERATING_SYSTEM=SUN
    ```

Note: No Linux connection exists at this time. You must use the **SUN** setting, as the connections for SCSI match closely.

---

17. Verify the changes:

    ```
    SHOW CONNECTIONS
    ```

    Mark or tag all Fibre Channel cables at both ends for ease of maintenance.

Repeating Procedure for Each Host Adapter Connection

18. Repeat steps 15, 16, and 17 for each of that adapter's host connections or delete the unwanted connections from the table.

19. For each host adapter, repeat steps 14 through 18.

Verifying Installation

To verify installation for your Linux host, restart your system as described in the previous chapter. After the system is booted, verify that your LUNs are accessible.

Configuring Devices

The disks on the device bus of the HSG80 can be configured manually or with the CONFIG utility. The CONFIG utility is easier. Invoke CONFIG with the following command:

```
RUN CONFIG
```

WARNING: HP recommends that you use the CONFIG utility only at reduced I/O loads.

The CONFIG utility takes about two minutes to discover and to map the configuration of a completely populated storage system.

Configuring Storage Containers

For a technology refresher on this subject, refer to "Choosing a Container Type", page 71.

In choosing a container, you choose between independent disks (JBODs) or one of several storageset types, as shown in Figure 38. The independent disks and the selected storageset may also be partitioned.

The following configurations are detailed in the following sections:

- "Configuring a Stripeset", page 140
- "Configuring a Mirrorset", page 140
- "Configuring a RAIDset", page 141
- "Configuring a Striped Mirrorset", page 142
- "Configuring a Single-Disk Unit (JBOD)", page 143
- "Configuring a Partition", page 143

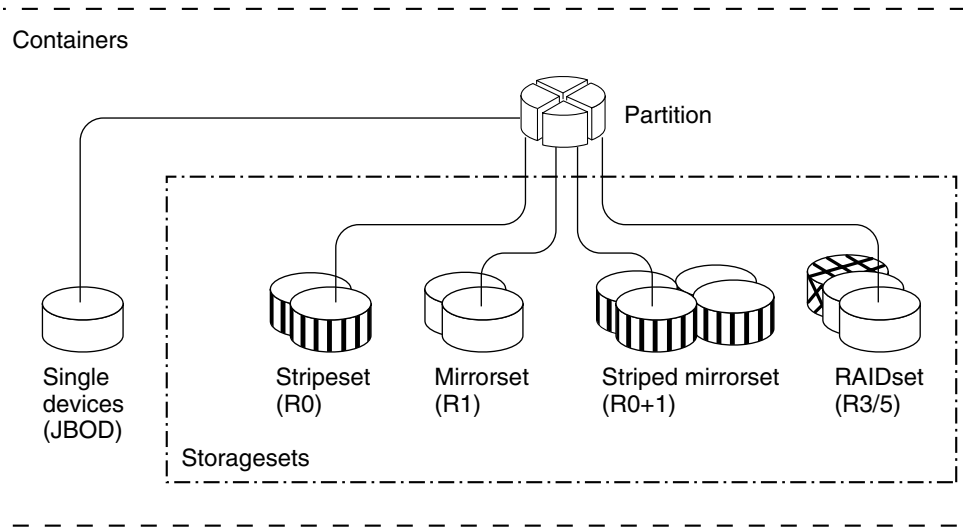


Figure 38: Storage container types

Configuring a Stripeset

1. Create the stripeset by adding its name to the controller's list of storagesets and by specifying the disk drives it contains. Use the following syntax:

   ```
   ADD STRIPESET STRIPESET-NAME DISKNNNNN DISKNNNNN.......
   ```

2. Initialize the stripeset, specifying any desired switches:

   ```
   INITIALIZE STRIPESET-NAME SWITCHES
   ```

   See "Specifying Initialization Switches", page 88, for a description of the initialization switches.

3. Verify the stripeset configuration:

   ```
   SHOW STRIPESET-NAME
   ```

4. Assign the stripeset a unit number to make it accessible by the hosts. See "Assigning Unit Numbers and Unit Qualifiers", page 145.

For example:
The commands to create Stripe1, a stripeset consisting of three disks (DISK10000, DISK20000, and DISK10100) and having a chunksize of 128:

```
ADD STRIPESET STRIPE1 DISK10000 DISK20000 DISK30000
INITIALIZE STRIPE1 CHUNKSIZE=128
SHOW STRIPE1
```

Configuring a Mirrorset

1. Create the mirrorset by adding its name to the controller's list of storagesets and by specifying the disk drives it contains. Optionally, you can append mirrorset switch values:

   ```
   ADD MIRRORSET MIRRORSET-NAME DISKNNNNN DISKNNNNN SWITCHES
   ```

Note: See the `ADD MIRRORSET` command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide* for a description of the mirrorset switches.

---

2. Initialize the mirrorset, specifying any desired switches:

   ```
   INITIALIZE MIRRORSET-NAME SWITCHES
   ```

   See "Specifying Initialization Switches", page 88, for a description of the initialization switches.

3. Verify the mirrorset configuration:

   ```
   SHOW MIRRORSET-NAME
   ```

4. Assign the mirrorset a unit number to make it accessible by the hosts. See "Assigning Unit Numbers and Unit Qualifiers", page 145.

For example:
The commands to create Mirr1, a mirrorset with two members (DISK10000 and DISK20000), and to initialize it using default switch settings:

```
ADD MIRRORSET MIRR1 DISK10000 DISK20000
INITIALIZE MIRR1
SHOW MIRR1
```

Configuring a RAIDset

1. Create the RAIDset by adding its name to the controller's list of storagesets and by specifying the disk drives it contains. Optionally, you can specify RAIDset switch values:

   ```
   ADD RAIDSET RAIDSET-NAME DISKNNNNN DISKNNNNN DISKNNNNN SWITCHES
   ```

Note: See the `ADD RAIDSET` command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide* for a description of the RAIDset switches.

---

2. Initialize the RAIDset, specifying any desired switches:

   ```
   INITIALIZE RAIDSET-NAME SWITCH
   ```

Note: HP recommends that you allow initial reconstruct to complete before allowing I/O to the RAIDset. Not doing so may generate forced errors at the host level. To determine whether initial reconstruct has completed, enter `SHOW RAIDSET FULL`.

   See "Specifying Initialization Switches", page 88, for a description of the initialization switches.

3. Verify the RAIDset configuration:

   ```
   SHOW RAIDSET-NAME
   ```

4. Assign the RAIDset a unit number to make it accessible by the hosts. See "Assigning Unit Numbers and Unit Qualifiers", page 145.

For example:
The commands to create RAID1, a RAIDset with three members (DISK10000, DISK20000, and DISK10100) and to initialize it with default values:

```
ADD RAIDSET RAID1 DISK10000 DISK20000 DISK30000
INITIALIZE RAID1
SHOW RAID1
```

Configuring a Striped Mirrorset

1. Create, but do not initialize, at least two mirrorsets.

   See "Configuring a Mirrorset", page 140.

2. Create a stripeset and specify the mirrorsets it contains:

   ```
   ADD STRIPESET STRIPESET-NAME MIRRORSET-1
   MIRRORSET-2....MIRRORSET-N
   ```

3. Initialize the striped mirrorset, specifying any desired switches:

   ```
   INITIALIZE STRIPESET-NAME SWITCH
   ```

   See "Specifying Initialization Switches", page 88, for a description of the initialization switches.

4. Verify the striped mirrorset configuration:

   ```
   SHOW STRIPESET-NAME
   ```

5. Assign the stripeset mirrorset a unit number to make it accessible by the hosts. See "Assigning Unit Numbers and Unit Qualifiers", page 145.

For example**:**
The commands to create Stripe1, a striped mirrorset that comprises Mirr1, Mirr2, and Mirr3, each of which is a two-member mirrorset:

```
ADD MIRRORSET MIRR1 DISK10000 DISK20000
ADD MIRRORSET MIRR2 DISK20100 DISK10100
ADD MIRRORSET MIRR3 DISK10200 DISK20200
ADD STRIPESET STRIPE1 MIRR1 MIRR2 MIRR3
INITIALIZE STRIPE1
SHOW STRIPE1
```

Configuring a Single-Disk Unit (JBOD)

1. Initialize the disk drive, specifying any desired switches:

   `INITIALIZE DISK-NAME SWITCHES`

   See "Specifying Initialization Switches", page 88, for a description of the initialization switches.

2. Verify the configuration by entering the following command:

   `SHOW DISK-NAME`

3. Assign the disk a unit number to make it accessible by the hosts. See "Assigning Unit Numbers and Unit Qualifiers", page 145.

Configuring a Partition

1. Initialize the storageset or disk drive, specifying any desired switches:

   `INITIALIZE STORAGESET-NAME SWITCHES`

   or

   `INITIALIZE DISK-NAME SWITCHES`

   See "Specifying Initialization Switches", page 88, for a description of the initialization switches.

2. Create each partition in the storageset or disk drive by indicating the partition's size. Also specify any desired switch settings:

   `CREATE_PARTITION STORAGESET-NAME SIZE=N SWITCHES`

   or

   `CREATE_PARTITION DISK-NAME SIZE=N SWITCHES`

   where N is the percentage of the disk drive or storageset that is assigned to the partition. Enter `SIZE=LARGEST`, on the last partition only, to let the controller assign the largest free space available to the partition.

Note: See the `CREATE_PARTITION` command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide* for a description of the partition switches.

---

3. Verify the partitions:

   `SHOW STORAGESET-NAME`

or

```
SHOW DISK-NAME
```

The partition number is displayed in the first column, followed by the size and starting block of each partition.

4. Assign the partition a unit number to make it accessible by the hosts. See "Assigning Unit Numbers and Unit Qualifiers", page 145.

For example:
The commands to create RAID1, a three-member RAIDset, then partition it into two storage units are shown below.

```
ADD RAIDSET RAID1 DISK10000 DISK20000 DISK30000
INITIALIZE RAID1
CREATE_PARTITION RAID1 SIZE=25
CREATE_PARTITION RAID1 SIZE=LARGEST
SHOW RAID1
```

Assigning Unit Numbers and Unit Qualifiers

Each storageset, partition, or single (JBOD) disk must be assigned a unit number for the host to access. As the units are added, their properties can be specified through the use of command qualifiers, which are discussed in detail under the ADD UNIT command in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Command Line Interface Reference Guide*.

Because of different SCSI versions, refer to the section "Assigning Unit Numbers Depending on SCSI_VERSION", page 44. The choice for SCSI_VERSION effects how certain unit numbers and host connection offsets interact.

Each unit can be reserved for the exclusive use of a host or group of hosts. See "Restricting Host Access in Transparent Failover Mode", page 46,

Assigning a Unit Number to a Storageset

To assign a unit number to a storageset, use the following syntax:

```
ADD UNIT UNIT-NUMBER STORAGESET-NAME
```

For example**:**
To assign unit D102 to RAIDset R1, use the following command:

```
ADD UNIT D102 R1
```

Assigning a Unit Number to a Single (JBOD) Disk

To assign a unit number to a single (JBOD) disk, use the following syntax:

```
ADD UNIT UNIT-NUMBER DISK-NAME
```

For example**:**
To assign unit D4 to DISK20300, use the following command:

```
ADD UNIT D4 DISK20300
```

Assigning a Unit Number to a Partition

To assign a unit number to a partition, use the following syntax:

```
ADD UNIT UNIT-NUMBER STORAGESET-NAME PARTITION=PARTITION-NUMBER
```

For example:
To assign unit D100 to partition 3 of mirrorset mirr1, use the following command:

```
ADD UNIT D100 MIRR1 PARTITION=3
```

Configuration Options

There are multiple options that allow you to configure your system.

Changing the CLI Prompt

To change the CLI prompt, enter a 1- to 16- character string as the new prompt, according to the following syntax:

```
SET THIS_CONTROLLER PROMPT = "NEW PROMPT"
```

If you are configuring dual-redundant controllers, also change the CLI prompt on the "other controller." Use the following syntax:

```
SET OTHER_CONTROLLER PROMPT = "NEW PROMPT"
```

Note: It is suggested that the prompt name reflect some information about the controllers. For example, if the subsystem is the third one in a lab, name the top controller prompt, LAB3A and the bottom controller, LAB3B.

Mirroring Cache

To specify mirrored cache, use the following syntax:

```
SET THIS MIRRORED_CACHE
```

Adding Disk Drives

If you add new disk drives to the subsystem, the disk drives must be added to the controllers' list of known devices:

- To add one new disk drive to the list of known devices, use the following syntax:

  ```
  ADD DISK DISKNNNNN P T L
  ```

- To add several new disk drives to the list of known devices, enter the following command:

  ```
  RUN CONFIG
  ```

Adding a Disk Drive to the Spareset

The spareset is a collection of spare disk drives that are available to the controller should it need to replace a failed member of a RAIDset or mirrorset.

Note: This procedure assumes that the disks that you are adding to the spareset have already been added to the controller's list of known devices.

To add the disk drive to the controller's spareset list, use the following syntax:

```
ADD SPARESET DISKNNNNN
```

Repeat this step for each disk drive you want to add to the spareset:

For example**:**
The following example shows the syntax for adding DISK11300 and DISK21300 to the spareset.

```
ADD SPARESET DISK11300
ADD SPARESET DISK21300
```

Removing a Disk Drive from the Spareset

You can delete disks in the spareset if you need to use them elsewhere in your subsystem.

1. Show the contents of the spareset entering the following command:

   ```
   SHOW SPARESET
   ```

2. Delete the desired disk drive entering the following command:

   ```
   DELETE SPARESET DISKNNNNN
   ```

   The `RUN CONFIG` command does not delete disks from the controllers' device table if a disk has been physically removed or replaced. In this case, you must use the command: `DELETE` *DISKNNNNN*.

3. Verify the contents of the spareset by entering the following command:

   ```
   SHOW SPARESET
   ```

Enabling Autospare

With `AUTOSPARE` enabled on the failedset, any new disk drive that is inserted into the PTL location of a failed disk drive is automatically initialized and placed into the spareset. If initialization fails, the disk drive remains in the failedset until you manually delete it from the failedset.

To enable autospare, use the following command:

```
SET FAILEDSET AUTOSPARE
```

To disable autospare, use the following command:

```
SET FAILEDSET NOAUTOSPARE
```

During initialization, AUTOSPARE checks to see if the new disk drive contains metadata. Metadata is information the controller writes on the disk drive when the disk drive is configured into a storageset. Therefore, the presence of metadata indicates that the disk drive belongs to, or has been used by, a storageset. If the disk drive contains metadata, initialization stops. (A new disk drive does not contain metadata but a repaired or reused disk drive might. To erase metadata from a disk drive, add it to the controller's list of devices, then set it to be nontransportable and initialize it.)

Deleting a Storageset

Note: If the storageset you are deleting is partitioned, you must delete each partitioned unit before you can delete the storageset.

1. Show the storageset's configuration:

   ```
   SHOW STORAGESET-NAME
   ```

2. Delete the unit number that uses the storageset. Use the following command:

   ```
   DELETE UNIT-NUMBER
   ```

3. Delete the storageset. Use the following command:

   ```
   DELETE STORAGESET-NAME
   ```

4. Verify the configuration:

   ```
   SHOW STORAGESET-NAME
   ```

Changing Switches for a Storageset or Device

You can optimize a storageset or device at any time by changing the switches that are associated with it. Remember to update the storageset profile when changing its switches.

Displaying the Current Switches

To display the current switches for a storageset or single-disk unit, enter a SHOW command, specifying the FULL switch:

```
SHOW STORAGESET-NAME
```

or

```
SHOW DEVICE-NAME
```

Note: FULL is not required when showing a particular device. It is used when showing all devices, for example, SHOW DEVICES FULL.

Changing RAIDset and Mirrorset Switches

Use the SET *storageset-name* command to change the RAIDset and Mirrorset switches associated with an existing storageset.

For example, the following command changes the replacement policy for RAIDset RAID1 to BEST_FIT:

```
SET RAID1 POLICY=BEST_FIT
```

Changing Device Switches

Use the SET *device-name* command to change the device switches.

For example, to request a data transfer rate of 20 MHz for DISK10000:

```
SET DISK10000 TRANSFER_RATE_REQUESTED=20MHZ
```

Changing Initialize Switches

The initialization switches cannot be changed without destroying the data on the storageset or device. These switches are integral to the formatting and can only be changed by reinitializing the storageset. Initializing a storageset is similar to formatting a disk drive; all data is destroyed during this procedure.

Changing Unit Switches

Use the SET *unit-name* command to change the characteristics of a unit.

For example, the following command enables write protection for unit D100:

```
SET D100 WRITE_PROTECT
```

Using CLI for Configuration

6

This chapter presents an example of how to configure a storage subsystem using the Command Line Interpreter (CLI). The CLI configuration example shown assumes:

- A normal, new controller pair, which includes:
  - NODE ID set
  - No previous failover mode
  - No previous topology set
- Two single-bus model 4214R disk enclosure shelves
- PCMCIA cards installed in both controllers

A storage subsystem example is shown in Figure 39. The example system contains three non-clustered Linux hosts, as shown in Figure 40. The resulting virtual system, from the host's point of view, is shown in Figure 41.

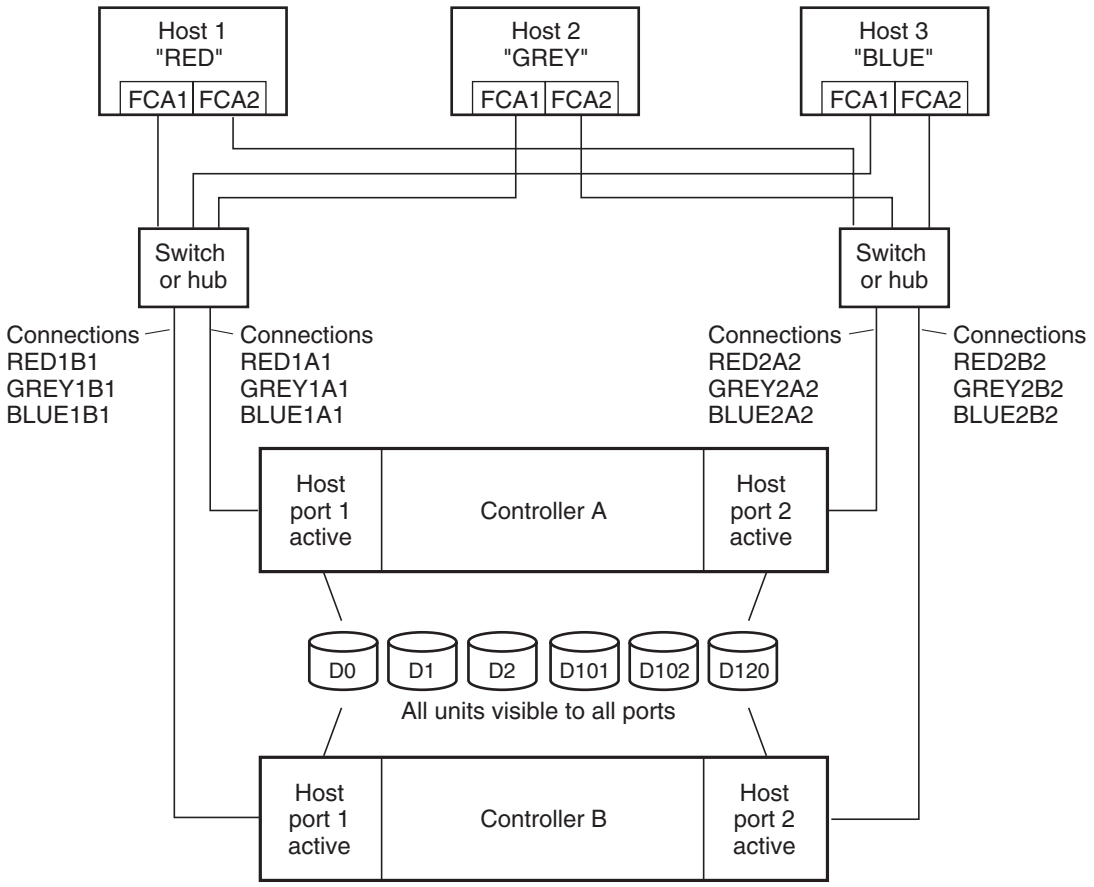
Figure 39 shows an example storage system map for the BA370 enclosure. Details on building your own map are described in Chapter 2. Templates to help you build your storage map are supplied in Appendix A.

Port							
	1	2	3	4	5	6	
Power Supply	D2 S2 DISK10300	D2 S2 DISK20300	D2 S2 DISK30300	D2 S2 DISK40300	D2 D101 DISK50300	spareset member DISK60300	Power Supply
Power Supply	D0 S1 MI DISK10200	D0 S1 M1 DISK20200	D0 S1 M2 DISK30200	D0 S1 M2 DISK40200	D1 M3 DISK50200	D1 M3 DISK60200	Power Supply
Power Supply	D120 R2 DISK10100	D120 R2 DISK20100	D120 R2 DISK30100	D120 R2 DISK40100	D120 R2 DISK50100	D120 R2 DISK60100	Power Supply
Power Supply	D102 R1 DISK10000	D102 R1 DISK20000	D102 R1 DISK30000	D102 R1 DISK40000	D102 R1 DISK50000	D102 R1 DISK60000	Power Supply

Targets: 3, 2, 1, 0

Figure 39: Example storage map for the BA370 enclosure

The example system, shown in Figure 40, contains three non-clustered hosts. Port 1 link is separate from port 2 link (that is, ports 1 of both controllers are on one loop or fabric, and port 2 of both controllers are on another). Therefore, each adapter has two connections. The target numbers represent what the third number of the disk number is. For example, if the disk number is disk10200, 2 is the target number.



NOTE: FCA = Fibre Channel Adapter

CXO7547B

Figure 40: Example, three non-clustered host systems

Figure 41 represents units that are logical or virtual disks comprised of storagesets configured from physical disks.

Figure 42 represents an example of virtual system layout from the hosts' point of view.

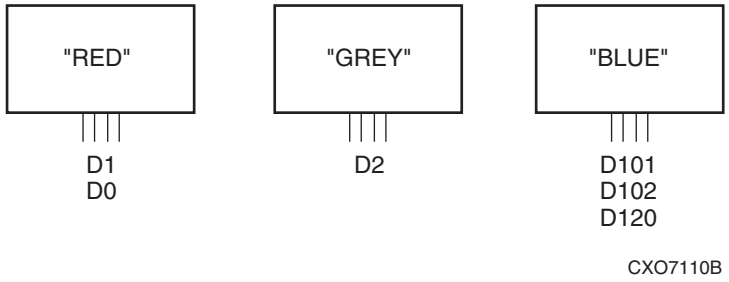


Figure 41: Example, logical or virtual disks comprised of storagesets

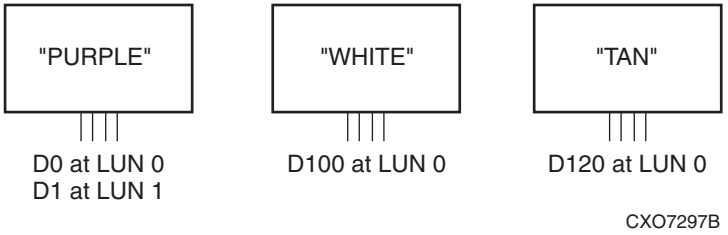


Figure 42: Example, virtual system layout from hosts' point of view

CLI Configuration Example

Text conventions used in this example are listed below:

- Text in *italics* indicates an action you take.
- Text in THIS FORMAT, indicates a command you type. Be certain to press **Enter** after each command.
- Text enclosed within a box, indicates information that is displayed by the CLI interpreter.

Note: "This" controller is top controller (A).

Plug serial cable from maintenance terminal into top controller.

```
CLEAR CLI
SET FAILOVER COPY=THIS
CLEAR CLI
SET THIS SCSI_VERSION=SCSI-3
SET THIS ALLOCATION_CLASS=0
RESTART OTHER
RESTART THIS
SET THIS TIME=10-Mar-2001:12:30:34
RUN FRUTIL
```

```
Do you intend to replace this controller's cache
battery? Y/N [Y]
```

```
Y
```

Plug serial cable from maintenance terminal into bottom controller.

Note: Bottom controller (B) becomes “this” controller.

```
RUN FRUTIL
```

```
Do you intend to replace this controller's cache
battery? Y/N [Y]
```

```
Y
SET THIS MIRRORED_CACHE
```

Note: This command causes the controllers to restart.

```
SET THIS PROMPT="HLNDR BOTTOM"
SET OTHER PROMPT="HLNDR TOP"
SHOW THIS
SHOW OTHER
```

Plug in the Fibre Channel cable from the adapter in host “PURPLE.”

```
SHOW CONNECTIONS
```

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
!NEWCON00	WINNT	THIS	1	XXXX XX	OL this	0
HOST_ID=XXXX-XXXX-XXXX-XXXX			ADAPTER_ID=XXXX-XXXX-XXXX-XXXX			

```
RENAME !NEWCON00 PURPLE1A1
SET PURPLE1A1 OPERATING_SYSTEM=SUN
SHOW CONNECTIONS
```

Note: Connection table sorts alphabetically.

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
RED1A1		OTHER	1	XXXX XX	OL other	0
HOST_ID=XXXX-XXXX-XXXX-XXXX			ADAPTER_ID=XXXX-XXXX-XXXX-XXXX			

Mark or tag both ends of Fibre Channel cables.

Plug in the Fibre Channel cable from the second adapter in host “WHITE.”

```
SHOW CONNECTIONS
```

Note: The offset for !NEWCONO1 is automatically set to 100 because it is plugged into host port 2.

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
!NEWCON01	WINNT	THIS	2	XXXXXX	OL this	100
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		
PURPLE1A1	SUN	OTHER	1	XXXXXX	OL other	0
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		

```
RENAME !NEWCON01 WHITE1B2
SET WHITE1B2 OPERATING_SYSTEM=SUN
SHOW CONNECTIONS
```

Mark or tag both end of Fibre Channel cables.

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
PURPLE1A1	SUN	OTHER	1	XXXXXX	OL other	0
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		
WHITE1B2	SUN	THIS	2	XXXXXX	OL this	100
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		

Plug in the Fibre Channel cable from the adapter in host “TAN”.

```
SHOW CONNECTIONS
```

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
!NEWCON02	SUN	THIS	2	XXXXXX	OL this	100
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		
PURPLE1A1	SUN	OTHER	1	XXXXXX	OL other	0
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		
WHITE1B2	SUN	THIS	2	XXXXXX	OL this	100
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		

```
RENAME !NEWCON02 TAN1B2
SET TAN1B2 OPERATING_SYSTEM=SUN
SET TAN1B2 UNIT_OFFSET=120
SHOW CONNECTIONS
```

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
PURPLE1A1	SUN	OTHER	1	XXXXXX	OL other	0
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		
WHITE1B2	SUN	THIS	2	XXXXXX	OL this	100
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		
TAN1B2	SUN	THIS	2	XXXXXX	OL this	120
HOST_ID=XXXX-XXXX-XXXX-XXXX				ADAPTER_ID=XXXX-XXXX-XXXX-XXXX		

Mark or tag both end of Fibre Channel cables.

```
RUN CONFIG

ADD RAIDSET R1 DISK10000 DISK20000 DISK30000 DISK40000 DISK50000
DISK60000

INITIALIZE R1

ADD UNIT D102 R1 DISABLE_ACCESS_PATH=ALL

SET D102 ENABLE_ACCESS_PATH=PURPLE1A1

ADD RAIDSET R2 DISK10100 DISK20100 DISK30100 DISK40100 DISK50100
DISK60100

INITIALIZE R2

ADD UNIT D120 R2 DISABLE_ACCESS_PATH=ALL

SET D120 ENABLE_ACCESS_PATH=(TAN1B2)

ADD MIRRORSET MI DISK10200 DISK20200

ADD MIRRORSET M2 DISK30200 DISK40200

ADD STRIPESET S1 M1 M2

INITIALIZE S1

ADD UNIT D0 S1 DISABLE_ACCESS_PATH=ALL

SET D0 ENABLE_ACCESS_PATH=PURPLE1A1

ADD MIRRORSET M3 DISK50200 DISK60200

INITIALIZE M3

ADD UNIT D1 M3 DISABLE_ACCESS_PATH=ALL

SET D1 ENABLE_ACCESS_PATH=(WHITE1B2)

ADD STRIPESET S2 DISK10300 DISK20300 DISK30300 DISK40300

INITIALIZE S2

ADD UNIT D2 S2 DISABLE_ACCESS_PATH=ALL

SET D2 ENABLE_ACCESS_PATH=PURPLE1A1

INITIALIZE DISK50300

ADD UNIT D101 DISK50300 DISABLE_ACCESS_PATH=ALL

SET D101 ENABLE_ACCESS_PATH=(WHITE1B2)

ADD SPARESET DISK60300

SHOW UNITS FULL
```

Backing Up, Cloning, and Moving Data

7

This chapter includes the following topics:

Backing Up Subsystem Configurations

The controller stores information about the subsystem configuration in its nonvolatile memory. This information could be lost if the controller fails or when you replace a module in the subsystem.

Use the following command to produce a display that shows if the save configuration feature is active and which devices are being used to store the configuration.

```
SHOW THIS_CONTROLLER FULL
```

The resulting display includes a line that indicates status and how many devices have copies of the configuration. The last line shows on how many devices the configuration is backed up.

Note: DO NOT use `SAVE_CONFIGURATION` in dual redundant controller installations. It is not supported and may result in unexpected controller behavior.

The `SHOW DEVICES FULL` command shows which disk drives are set up to back up the configuration. The syntax for this command is shown below:

```
SHOW DEVICES FULL
```

Creating Clones for Backup

Use the Clone utility to duplicate the data on any unpartitioned single-disk unit, stripeset, mirrorset, or striped mirrorset in preparation for backup. When the cloning operation is complete, you can back up the Clones rather than the storageset or single-disk unit, which can continue to service its I/O load. When you are cloning a mirrorset, Clone does not need to create a temporary mirrorset. Instead, it adds a temporary member to the mirrorset and copies the data onto this new member.

The Clone utility creates a temporary, two-member mirrorset for each member in a single-disk unit or stripeset. Each temporary mirrorset contains one disk drive from the unit you are cloning and one disk drive onto which Clone copies the data. During the copy operation, the unit remains online and active so that the Clones contain the most up-to-date data.

After the Clone utility copies the data from the members to the Clones, it restores the unit to its original configuration and creates a Clone unit you can back up. The Clone utility uses the steps shown in Figure 43 to duplicate each member of a unit.

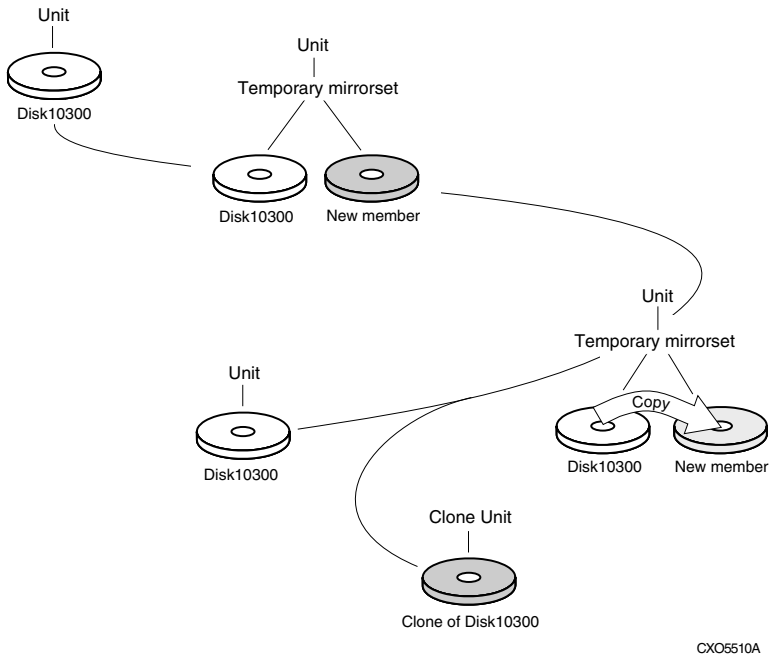


Figure 43: Clone utility steps for duplicating unit members

To Clone a single-disk unit, stripeset, or mirrorset:

1. Establish a connection to the controller that accesses the unit you want to Clone.
2. Start Clone using the following command:

   ```
   RUN CLONE
   ```

3. When prompted, enter the unit number of the unit you want to Clone.
4. When prompted, enter a unit number for the Clone unit that Clone creates.
5. When prompted, indicate how you would like the Clone unit to be brought online: either automatically or only after your approval.
6. When prompted, enter the disk drives you want to use for the Clone units.
7. Back up the Clone unit.

The following example shows the commands you would use to Clone storage unit D6. The Clone command terminates after it creates storage unit D33, a Clone or copy of D6.

```
RUN CLONE

CLONE LOCAL PROGRAM INVOKED

UNITS AVAILABLE FOR CLONING:

                98

ENTER UNIT TO CLONE? 98

CLONE WILL CREATE A NEW UNIT WHICH IS A COPY OF UNIT 98.

ENTER THE UNIT NUMBER WHICH YOU WANT ASSIGNED TO THE NEW UNIT?
99

THE NEW UNIT MAY BE ADDED USING ONE OF THE FOLLOWING METHODS:

1. CLONE WILL PAUSE AFTER ALL MEMBERS HAVE BEEN COPIED. THE USER
MUST THEN PRESS RETURN TO CAUSE THE NEW UNIT TO BE ADDED.

2. AFTER ALL MEMBERS HAVE BEEN COPIED, THE UNIT WILL BE ADDED
AUTOMATICALLY.

UNDER WHICH ABOVE METHOD SHOULD THE NEW UNIT BE ADDED[ ]?1

DEVICES AVAILABLE FOR CLONE TARGETS:

DISK20200 (SIZE=832317)

DISK20300 (SIZE=832317)

USE AVAILABLE DEVICE DISK20200(SIZE=832317) FOR MEMBER
DISK10300(SIZE=832317) (Y,N) [Y]? Y

MIRROR DISK10300 C_MA

SET C_MA NOPOLICY

SET C_MA MEMBERS=2

SET C_MA REPLACE=DISK20200

DEVICES AVAILABLE FOR CLONE TARGETS:

DISK20300 (SIZE=832317)

USE AVAILABLE DEVICE DISK20300(SIZE=832317) FOR MEMBER
DISK10000(SIZE=832317) (Y,N) [Y]? Y

MIRROR DISK10000 C_MB

SET C_MB NOPOLICY

SET C_MB MEMBERS=2

SET C_MB REPLACE=DISK20300

COPY IN PROGRESS FOR EACH NEW MEMBER. PLEASE BE PATIENT...

.
```

```
.
COPY FROM DISK10300 TO DISK20200 IS 100% COMPLETE
COPY FROM DISK10000 TO DISK20300 IS 100% COMPLETE
PRESS RETURN WHEN YOU WANT THE NEW UNIT TO BE CREATED
REDUCE DISK20200 DISK20300
UNMIRROR DISK10300
UNMIRROR DISK10000
ADD MIRRORSET C_MA       DISK20200
ADD MIRRORSET C_MB       DISK20300
ADD STRIPESET C_ST1 C_MA C_MB
INIT C_ST1     NODESTROY
ADD UNIT D99 C_ST1
D99 HAS BEEN CREATED. IT IS A CLONE OF D98.
CLONE - NORMAL TERMINATION
```

Moving Storagesets

You can move a storageset from one subsystem to another without destroying its data. You also can follow the steps in this section to move a storageset to a new location within the same subsystem.

Caution: Move only normal storagesets. Do not move storagesets that are reconstructing or reduced, or data corruption results.

See the release notes for the version of your controller software for information on which drives can be supported.

Caution: Never initialize any container or this procedure does not protect data in the storageset.

Use the following procedure to move a storageset, while maintaining the data the storageset contains:

1. Show the details for the storageset you want to move. Use the following command:

   `SHOW STORAGESET-NAME`

2. Label each member with its name and PTL location.

   If you do not have a storageset map for your subsystem, you can enter the `LOCATE` command for each member to find its PTL location. Use the following command:

   `LOCATE DISK-NAME`

   To cancel the locate command, enter the following:

   `LOCATE CANCEL`

3. Delete the unit number shown in the "Used by" column of the `SHOW` *storageset-name* command. Use the following syntax:

   `DELETE UNIT-NUMBER`

4. Delete the storageset shown in the "Name" column of the `SHOW` *storageset-name* command. Use the following syntax:

   `DELETE STORAGESET-NAME`

5. Delete each disk drive, one at a time, that the storageset contained. Use the following syntax:

   ```
   DELETE DISK-NAME
   DELETE DISK-NAME
   DELETE DISK-NAME
   ```

6. Remove the disk drives and move them to their new PTL locations.
7. Again add each disk drive to the controller's list of valid devices. Use the following syntax:

   ```
   ADD DISK DISK-NAME PTL-LOCATION
   ADD DISK DISK-NAME PTL-LOCATION
   ADD DISK DISK-NAME PTL-LOCATION
   ```

8. Recreate the storageset by adding its name to the controller's list of valid storagesets and by specifying the disk drives it contains. (Although you have to recreate the storageset from its original disks, you do not have to add the storagesets in their original order.) Use the following syntax to recreate the storageset:

   ```
   ADD STORAGESET-NAME DISK-NAME DISK-NAME
   ```

9. Represent the storageset to the host by giving it a unit number the host can recognize. You can use the original unit number or create a new one. Use the following syntax:

   ```
   ADD UNIT UNIT-NUMBER STORAGESET-NAME
   ```

The following example moves unit D100 to another cabinet. D100 is the RAIDset RAID99 that consists of members DISK10000, DISK20000, and DISK10100.

Old cabinet

```
DELETE D100
DELETE RAID99
DELETE DISK10000
DELETE DISK10100
DELETE DISK20000
DELETE DISK20100
```

New cabinet

```
ADD DISK DISK10000
ADD DISK DISK10100
ADD DISK DISK20000
ADD DISK DISK20100
ADD RAIDSET RAID99 DISK10000 DISK10100 DISK20000 DISK20100
ADD UNIT D100 RAID99
```

Subsystem Profile Templates

This appendix contains storageset profiles to copy and use to create your profiles. It also contains an enclosure template to use to help keep track of the location of devices and storagesets in your shelves. Four (4) templates are needed for the subsystem.

Note: The storage map templates for the Model 4310R and Model 4214R or 4314R reflect the physical location of the disk enclosures in the rack. Disk enclosures 6, 5, and 4 are stacked above the controller enclosure and disk enclosures 1, 2, and 3 are stacked below the controller enclosure.

Storageset Profile

Type of Storageset:

_____ Mirrorset	__X_ RAIDset	_____ Stripeset	_____ Striped Mirrorset	____ JBOD

Storageset Name

Disk Drives

Unit Number

Partitions:

Unit #	Unit #	Unit #	Unit #	Unit #	Unit #	Unit #	Unit #

RAIDset Switches:

Reconstruction Policy	Reduced Membership	Replacement Policy
__Normal (default)	___No (default)	___Best performance (default)
___Fast	___Yes, missing:	___Best fit
		___None

Mirrorset Switches:

Replacement Policy	Copy Policy	Read Source
___Best performance (default)	___Normal (default)	___Least busy (default)
___Best fit	___Fast	___Round robin
___None		___Disk drive:

Initialize Switches:

Chunk size	Save Configuration	Metadata
___ Automatic (default)	___No (default)	___Destroy (default)
___ 64 blocks	___Yes	___Retain
___ 128 blocks		
___ 256 blocks		
___ Other:		

Unit Switches:

Caching	Access by following hosts enabled
Read caching_____	_____
Read-ahead caching_____	_____
Write-back caching_____	_____
Write-through caching_____	_____
	_____
	_____
	_____

Storage Map Template 1 for the BA370 Enclosure

Use this template for:

- BA370 single-enclosure subsystems
- first enclosure of multiple BA370 enclosure subsystems

Port 1	2	3	4	5	6		Targets
Power Supply	D10300	D20300	D30300	D40300	D50300	D60300	Power Supply	3
Power Supply	D10200	D20200	D30200	D40200	D50200	D60200	Power Supply	2
Power Supply	D10100	D20100	D30100	D40100	D50100	D60100	Power Supply	1
Power Supply	D10000	D20000	D30000	D40000	D50000	D60000	Power Supply	0

Storage Map Template 2 for the Second BA370 Enclosure

Use this template for the second enclosure of multiple BA370 enclosure subsystems.

	Port 1	2	3	4	5	6		Targets
Power Supply	D11100	D21100	D31100	D41100	D51100	D61100	Power Supply	11
Power Supply	D11000	D21000	D31000	D41000	D51000	D61000	Power Supply	10
Power Supply	D10900	D20900	D30900	D40900	D50900	D60900	Power Supply	9
Power Supply	D10800	D20800	D30800	D40800	D50800	D60800	Power Supply	8

Storage Map Template 3 for the Third BA370 Enclosure

Use this template for the third enclosure of multiple BA370 enclosure subsystems.

	Port 1	2	3	4	5	6		
Power Supply	D11500	D21500	D31500	D41500	D51500	D61500	Power Supply	15
Power Supply	D11400	D21400	D31400	D41400	D51400	D61400	Power Supply	14
Power Supply	D11300	D21300	D31300	D41300	D51300	D61300	Power Supply	13
Power Supply	D11200	D21200	D31200	D41200	D51200	D61200	Power Supply	12

Targets

Storage Map Template 4 for the Model 4214R Disk Enclosure

Use this template for a subsystem with a three-shelf Model 4214R disk enclosure (single-bus). You can have up to six Model 4214R disk enclosures per controller shelf.

Model 4214R Disk Enclosure Shelf 1 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	0 0	0 1	0 2	0 3	0 4	0 5	0 8	0 9	1 0	1 1	1 2	1 3	1 4	1 5
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk10900	Disk11000	Disk11100	Disk11200	Disk11300	Disk11400	Disk11500

Model 4214R Disk Enclosure Shelf 2 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	0 0	0 1	0 2	0 3	0 4	0 5	0 8	0 9	1 0	1 1	1 2	1 3	1 4	1 5
DISK ID	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800	Disk20900	Disk21000	Disk21100	Disk21200	Disk21300	Disk21400	Disk21500

Model 4214R Disk Enclosure Shelf 3 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	0 0	0 1	0 2	0 3	0 4	0 5	0 8	0 9	1 0	1 1	1 2	1 3	1 4	1 5
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk30900	Disk31000	Disk31100	Disk31200	Disk31300	Disk31400	Disk31500

Storage Map Template 5 for the Model 4254 Disk Enclosure

Use this template for a subsystem with a three-shelf Model 4254 disk enclosure (dual-bus). You can have up to three Model 4254 disk enclosures per controller shelf.

Model 4254 Disk Enclosure Shelf 1 (Dual-bus)														
	Bus A							Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	0 0	0 1	0 2	0 3	0 4	0 5	0 8	0 0	0 1	0 2	0 3	0 4	0 5	0 8
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800

Model 4254 Disk Enclosure Shelf 2 (Dual-bus)														
	Bus A							Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	0 0	0 1	0 2	0 3	0 4	0 5	0 8	0 0	0 1	0 2	0 3	0 4	0 5	0 8
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800

continued on the following page

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Model 4254 Disk Enclosure Shelf 3 (Dual-bus)														
	Bus A							Bus B						
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800

Storage Map Template 6 for the Model 4310R Disk Enclosure

Use this template for a subsystem with a six-shelf Model 4310R disk enclosure (single-bus). You can have up to six Model 4310R disk enclosures per controller shelf.

Model 4310R Disk Enclosure Shelf 6 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800	Disk61000	Disk61100	Disk61200

Model 4310R Disk Enclosure Shelf 5 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk51000	Disk51100	Disk51200

Model 4310R Disk Enclosure Shelf 4 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800	Disk41000	Disk41100	Disk41200

Model 4310R Disk Enclosure Shelf 1 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk11000	Disk11100	Disk11200

Model 4310R Disk Enclosure Shelf 2 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800	Disk21000	Disk21100	Disk21200

Model 4310R Disk Enclosure Shelf 3 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk31000	Disk31100	Disk31200

Storage Map Template 7 for the Model 4350R Disk Enclosure

Use this template for a subsystem with a three-shelf Model 4350R disk enclosure (single-bus). You can have up to three Model 4350R disk enclosures per controller shelf.

Model 4350R Disk Enclosure Shelf 6 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800	Disk61000	Disk61100	Disk61200

Model 4350R Disk Enclosure Shelf 5 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk51000	Disk51100	Disk51200

Model 4350R Disk Enclosure Shelf 4 (Single-bus)										
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SCSI ID	00	01	02	03	04	05	08	10	11	12
DISK ID	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800	Disk41000	Disk41100	Disk41200

Storage Map Template 8 for the Model 4314R Disk Enclosure

Use this template for a subsystem with a six-shelf Model 4314R disk enclosure. You can have a maximum of six Model 4314R disk enclosures with each Model 2200 controller enclosure.

Model 4314R Disk Enclosure Shelf 6 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800	Disk60900	Disk61000	Disk61100	Disk61200	Disk61300	Disk61400	Disk61500

Model 4314R Disk Enclosure Shelf 5 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk50900	Disk51000	Disk51100	Disk51200	Disk51300	Disk51500	Disk51500

Model 4314R Disk Enclosure Shelf 4 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800	Disk40900	Disk41000	Disk41100	Disk41200	Disk41300	Disk41400	Disk41500

Model 4314R Disk Enclosure Shelf 1 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk10900	Disk11000	Disk11100	Disk11200	Disk11300	Disk11400	Disk11500

Model 4314R Disk Enclosure Shelf 2 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800	Disk20900	Disk21000	Disk21100	Disk21200	Disk21300	Disk21400	Disk21500

Model 4314R Disk Enclosure Shelf 3 (Single-bus)														
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	09	10	11	12	13	14	15
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk30900	Disk31000	Disk31100	Disk31200	Disk31300	Disk31400	Disk31500

Storage Map Template 9 for the Model 4354R Disk Enclosure

Use this template for a subsystem with a three-shelf Model 4354R disk enclosure (dual-bus). You can have up to three Model 4354R disk enclosures per controller shelf.

Model 4354R Disk Enclosure Shelf 1 (Dual-bus)														
	SCSI Bus A							SCSI Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk10000	Disk10100	Disk10200	Disk10300	Disk10400	Disk10500	Disk10800	Disk20000	Disk20100	Disk20200	Disk20300	Disk20400	Disk20500	Disk20800

Model 4354R Disk Enclosure Shelf 2 (Dual-bus)														
	SCSI Bus A							SCSI Bus B						
Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk30000	Disk30100	Disk30200	Disk30300	Disk30400	Disk30500	Disk30800	Disk40000	Disk40100	Disk40200	Disk40300	Disk40400	Disk40500	Disk40800

Model 4354R Disk Enclosure Shelf 3 (Dual-bus)														
	SCSI Bus A							SCSI Bus B						
Bay	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
SCSI ID	00	01	02	03	04	05	08	00	01	02	03	04	05	08
DISK ID	Disk50000	Disk50100	Disk50200	Disk50300	Disk50400	Disk50500	Disk50800	Disk60000	Disk60100	Disk60200	Disk60300	Disk60400	Disk60500	Disk60800

Installing, Configuring, and Removing the Client

The following information is included in this appendix:

Why Install the Client?

The Client monitors and manages a storage subsystem by performing the following tasks:

- Create mirrored device group (RAID 1)
- Create striped device group (RAID 0)
- Create striped mirrored device group (RAID 0+1)
- Create striped parity device group (3/5)
- Create an individual device (JBOD)
- Monitor many subsystems at once
- Set up pager notification

Before You Install the Client

1. Verify that you are logged into an account that is a member of the administrator group.
2. Check the software product description that came with the software for a list of supported hardware.
3. Verify that you have the SNMP service installed on the computer. SNMP must be installed on the computer for this software to work properly. The Client software uses SNMP to receive traps from the Agent. The SNMP service is available on the Windows NT, Windows 2000, and Windows Server 2003 installation web kit. To verify that you have the SNMP service:
   - For Windows NT, double-click Services in **Start > Settings > Control Panel**. The entry for SNMP is shown in this window. If you install the SNMP service and you already have Windows NT Service Pack 6A on the computer, reinstall the service pack after installing the SNMP service.
   - For Windows 2000 and Windows Server 2003, click **Start > Settings > Control Panel > Administrative Tools > Services.** The entry for SNMP is shown in the Services window.
4. Read the release notes.
5. Read "Installing the Integration Patch", page 197, in this appendix.
6. If you have the Command Console Client open, exit the Command Console Client.
7. If you have Command Console Client V1.1b or earlier, remove the program with the Windows **Add/Remove Programs** utility.
8. If you have a previous version of Command Console, you can save the Navigation Tree configuration by copying the `SWCC2.MDB` file to another directory. After you have installed the product, move `SWCC2.MDB` to the directory to which you installed SWCC.
9. Install the HS-Series Agent. For more information, see Chapter 4.

Installing the Client

The following restriction should be observed when installing SWCC on Windows NT 4.0 Workstations.

If you select all of the applets during installation, the installation fails on the HSG60 applet and again on one of the HSG80 applets. The workaround is to install all of the applets you want except for the HSG60 applet and the HSG80 ACS 8.5 applet. You can then return to the setup program and install the one that you need.

1. In a SAN environment where you would need both HSG60 and HSG80 subsystems, HP recommends you install both, but one at a time. This problem is not seen under Windows NT 4.0 Server.
2. Insert the CD-ROM into a computer running Windows 2000 with Service Pack 4, Windows NT 4.0 (Intel) with Service Pack 6.0A, or Windows Server 2003.

A dialog box is displayed.

3. One of the items in the dialog box should say **SWCC Client Software** and has a button that says **INSTALL** next to it. Click on the button to start the SWCC Client installation procedure.
4. Select the **HSG80 Controller for ACS85** or newer menu option to properly install SWCC Client, and click **Next**.

If this method does not work, run the `setup.exe` program.

Note: If the computer does not find a previous installation, it installs the SWCC Navigation Window and the CLI Window.

---

5. Follow the instructions on the screen. After you install the software, the Asynchronous Event Service (AES) starts. AES is a service that runs in the background. It collects and passes traps from the subsystems to the Navigation Tree and to individual pagers (for example, to show that a disk has failed). AES needs to be running for the Client system to receive updates.

Note: For more information on AES, see *HP StorageWorks Command Console V2.5 User Guide*.

Installing the Integration Patch

The integration patch determines which version of firmware the controller is using and launches the appropriate StorageWorks Command Console (SWCC) Storage Window within Insight Manager (CIM) V4.23.

Should I Install the Integration Patch?

Install this patch if your HSG80 controller uses ACS 8.6 or later. This patch enables you to use the controller's SWCC Storage Window within CIM to monitor and manage the controller.

Installing the Integration Patch

Perform the following steps to install the integration patch.

1. Verify that you have installed the HSG80 Storage Window for ACS 8.6 or later in the **Add/Remove Programs** in the Windows Control Panel. The HSG80 Storage Window for ACS 8.6 or later is needed to open the correct Storage Window for your version of the firmware.
2. Verify that you have installed HSG80 Storage Window V2.1 in the **Add/Remove Programs** (HP StorageWorks HSG80 V2.1) in the Windows Control Panel. The HSG80 Storage Window V2.1 is required to run the integration patch.
3. Verify that you have installed CIM V4.23.
4. Install the integration patch from the Solution Software CD-ROM by double-clicking on `setup.exe` in the following directory:

   `\SWCC\Client\HSG80shim`

   The patch is installed in the same location as the original SWCC installation.

Caution: Do not remove the HSG80 Client from your computer. If you remove the HSG80 Client, you no longer are able to access its Storage Window.

Caution: If you remove the integration patch, HSG80 Storage Window V2.1 no longer works and you need to reinstall HSG80 Storage Window V2.1. The integration patch uses some of the same files as the HSG80 Storage Window V2.1.

Integrating Controller's SWCC Storage Window with CIM

You can open the controller's Storage Window from within the Windows-based CIM V4.23 by doing the following:

1. Verify that you have installed the following by looking in **Add/Remove Programs** in Control Panel:
   - The HSG80 Storage Window for ACS V8.6 or later (Required to open the correct Storage Window for your firmware).
   - The HSG80 Storage Window V2.1 (HP StorageWorks HSG80 V2.1) The CIM integration patch uses files in this program.
   - CIM V4.23.
   - CIM integration patch (HSG80 Insight Manager Shim).
2. Verify that you have installed the CIM Agent and the StorageWorks Command Console HS-Series Agent on the same computer.
3. Add the name of the Client system that has CIM to the Agent's list of Client system entries and choose SNMP as a notification scheme.
4. Open Insight Manager.
5. To open the Server window, click on the device you want to observe in the CIM Navigation window.
6. Click on the **Mass Storage** button in the Server window. The **CIM Navigation Tree** opens.
7. Click on the **+** symbol next to **RAID Storage System**. The Navigation Tree expands to display a listing called **Storage System Information**.
8. Double-click **Storage System Information**. You are given the status of the system.
9. Click **Launch**. The controller's Storage Window opens.

"Insight Manager Unable to Find Controller's Storage Window"

If you installed Insight Manager before SWCC, Insight Manager is unable to find the controller's Storage Window. To find the controller's Storage Window, perform the following procedure:

1. Double-click the **Insight Agents** icon (**Start > Settings > Control Panel**). A window is displayed showing you the active and inactive Agents under the **Services** tab.
2. Highlight the entry for **Fibre Array Information** and click **Add**. The Fibre Array Information entry is moved from **Inactive Agents** to **Active Agents**.

Troubleshooting Client Installation

This section provides information on how to resolve some of the problems that may occur when installing the Client software:

- Invalid Network Port Assignments During Installation
- "There is no disk in the drive" Message

Invalid Network Port Assignments During Installation

SWCC Clients and Agents communicate by using sockets. The SWCC installation attempts to add entries into each system list of services (services file or for UCX, the local services database). If the SWCC installation finds an entry in the local services file with the same name as the one it wants to add, it assumes the one in the file is correct.

The SWCC installation may display a message, stating that it cannot upgrade the services file. This happens if it finds an entry in the local services file with the same number as the one it wants to add, but with a different name. In that case, appropriate port numbers must be obtained for the network and added manually to the services file.

There are two default port numbers, one for Command Console (4998) and the other for the device-specific Agent and Client software, such as the Fibre Channel Interconnect Client and Agent (4989). There are two exceptions. The following software has two default port numbers:

- The KZPCC Agent and Client, (4991 and 4985)
- The RA200 Agent and Client, (4997 and 4995)

Check your `/etc./services` file to verify named port lookup services.The following shows how the network port assignments display in the services file:

spgui	4998/tcp	#Command Console
ccdevmgt	4993/tcp	#Device Management Client and Agent
kzpccconnectport	4991/tcp	#KZPCC Client and Agent
kzpccdiscoveryport	4985/tcp	#KZPCC Client and Agent
ccfabric	4989/tcp	#Fibre Channel Interconnect Agent

spagent	4999/tcp	#HS-Series Client and Agent
spagent3	4994/tcp	#HSZ22 Client and Agent
ccagent	4997/tcp	#RA200 Client and Agent
spagent2	4995/tcp	#RA200 Client and Agent

"There is no disk in the drive" Message

When you install the Command Console Client, the software checks the shortcuts on the desktop and in the Start menu. The installation checks the shortcuts of all users for that computer, even if they are not currently logged on. You may receive an error message if any of these shortcuts point to empty floppy drives, empty CD-ROM drives, or missing removable disks. Do one of the following:

- Ignore the error message by clicking **Ignore**.
- Replace the removable disks, and place a disk in the floppy drive and a CD-ROM in the CD-ROM drive. Then, click **Retry**.

Adding Storage Subsystem and its Host to Navigation Tree

The Navigation Tree enables you to manage storage over the network by using the Storage Window. If you plan to use pager notification, you must add the storage subsystem to the Navigation Tree.

1. Verify that you have properly installed and configured the HS-Series Agent on the storage subsystem host.
2. Click **Start > Programs > Command Console > StorageWorks Command Console**.

The Client displays the Navigation Window. The Navigation Window lets you monitor and manage many storage subsystems over the network.

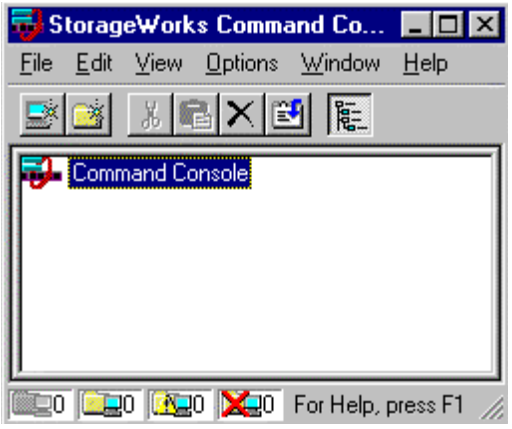

Figure 44: Navigation window

3. Click **File > Add System**.

The Add System window is displayed.

4. Type the host name or its TCP/IP address and click **Apply**.
5. Click **Close**.

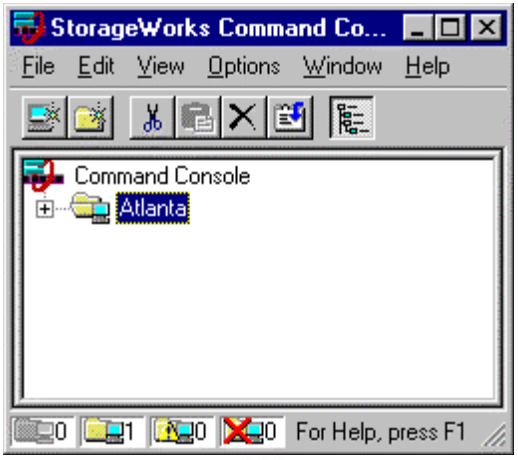

Figure 45: Navigation window showing storage host system "Atlanta"

6. Click the plus sign to expand the host icon. When expanded, the Navigation Window displays an icon for the storage subsystem. To access the Storage Window for the subsystem, double-click the Storage Window icon.

Figure 46: Navigation window showing expanded "Atlanta" host icon

Note: You can create virtual disks by using the Storage Window. For more information on the Storage Window, refer to *HP StorageWorks Command Console V2.5 User Guide*.

Removing Command Console Client

Before you remove the Command Console Client from the computer, remove AES. This prevents the system from reporting that a service failed to start every time the system is restarted. Steps 2 through 5 describe how to remove the Command Console Client.

Note: When you remove the Command Console Client, the `SWCC2.MDB` file is deleted. This file contains the Navigation Tree configuration. If you want to save this information, move the file to another directory.

1. Click **Start > Programs > StorageWorks Command Console** and change to the directory where you installed the Command Console Client.
2. Enter the following command:

   ```
   C:\Program Files\Compaq\SWCC>   AsyncEventService -remove
   ```

3. Do one of the following:
   - On Windows NT 4.0, click **Start > Settings > Control Panel**, and double-click the **Add/Remove Programs** icon in the Control Panel. The **Add/Remove Program Propertie**s window is displayed.
   - On Windows 2000 and Windows Server 2003, click **Start > Settings > Control Panel > Add/Remove Programs**. The **Add/Remove Programs** window is displayed.
4. Select **Command Console** in the window.
5. Do one of the following:
   - On Windows NT 4.0, click **Add/Remove.**
   - On Windows 2000 and Windows Server 2003, click **Change/Remove**.
6. Follow the instructions on the screen.

Note: This procedure removes only the Command Console Client (SWCC Navigation Window). You can remove the HSG80 Client by using the Add/Remove program.

Where to Find Additional Information

You can find additional information about SWCC by referring to the online Help and to *HP StorageWorks Command Console V2.5 User Guide*.

About the User Guide

HP StorageWorks Command Console V2.5 User Guide contains additional information on how to use SWCC. Some of the topics in the user guide are the following:

- About AES
- Adding Devices
- Adding Virtual Disks
- Setting Up Pager Notification
- How to Integrate SWCC with Insight Manager
- Troubleshooting Information

About the Online Help

Most of the information about the Client is provided in the online Help. Online Help is provided in two places:

- Navigation Window—Online Help provides information on pager notification and a tour of the Command Console Client, in addition to information on how to add a system to the Navigation Tree.
- Storage Window—Online Help provides detailed information about the Storage Window, such as how to create virtual disks.

glossary

This glossary defines terms pertaining to the ACS solution software. It is not a comprehensive glossary of computer terms.

8B/10B A type of byte definition encoding and decoding to reduce errors in data transmission patented by the IBM Corporation. This process of encoding and decoding data for transmission has been adopted by ANSI.

adapter A device that converts the protocol and hardware interface of one bus type into another without changing the function of the bus.

ACS *See* array controller software.

AL_PA *See* arbitrated loop physical address.

alias address An AL_PA value recognized by an arbitrated loop port in addition to the assigned AL_PA.

ANSI Pronounced “ann-see.” Acronym for the American National Standards Institute. An organization who develops standards used voluntarily by many manufacturers within the USA. ANSI is not a government agency.

arbitrate A process of selecting one L_Port from a collection of several ports that request use of the arbitrated loop concurrently.

arbitrated loop A loop type of topology where two or more ports can be interconnected, but only two ports at a time can communicate.

arbitrated loop physical address Abbreviated AL_PA. A one-byte value used to identify a port in an Arbitrated Loop topology.

array controller *See* controller.

array controller software Abbreviated ACS. Software contained on a removable ROM program card that provides the operating system for the array controller.

association set A group of remote copy sets that share selectable attributes for logging and failover. Members of an association set transition to the same state simultaneously. For example, if one association set member assumes the failsafe locked condition, then other members of the association set also assume the failsafe locked condition.

An association set can also be used to share a log between a group of remote copy set members that require efficient use of the log space.

asynchronous Pertaining to events that are scheduled as the result of a signal asking for the event; pertaining to that which is without any specified time relation. *See also* synchronous.

autospare A controller feature that automatically replaces a failed disk drive. To aid the controller in automatically replacing failed disk drives, you can enable the AUTOSPARE switch for the failedset causing physically replaced disk drives to be automatically placed into the spareset. Also called "AUTONEWSPARE."

bad block A data block that contains a physical defect.

bad block replacement Abbreviated BBR. A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller, transparent to the host.

backplane The electronic printed circuit board into which you plug subsystem devices—for example, the SBB or power supply.

battery hysteresis The ability of the software to allow write-block caching during the time a battery is charging, but only when a previous down time has not drained more than 50 percent of rated battery capacity.

BBR *See* bad block replacement.

BIST *See* built-in self-test.

bit A single binary digit having a value of either 0 or 1. A bit is the smallest unit of data a computer can process.

block Also called a sector. The smallest collection of consecutive bytes addressable on a disk drive. In integrated storage elements, a block contains 512 bytes of data, error codes, flags, and the block address header.

bootstrapping A method used to bring a system or device into a defined state by means of its own action. For example, a machine routine whose first few instructions are enough to bring the rest of the routine into the computer from an input device.

built-in self-test A diagnostic test performed by the array controller software on the controller policy processor.

byte A binary character string made up of 8 bits operated on as a unit.

cache memory A portion of memory used to accelerate read and write operations.

cache module A fast storage buffer

CCL CCL-Command Console LUN, a "SCSI Logical Unit Number" virtual-device used for communicating with Command Console Graphical User Interface (GUI) software.

channel An interface that allows high speed transfer of large amounts of data. Another term for a SCSI bus. *See also* SCSI.

chunk A block of data written by the host.

chunk size The number of data blocks, assigned by a system administrator, written to the primary RAIDset or stripeset member before the remaining data blocks are written to the next RAIDset or stripeset member.

CLCP An abbreviation for code-load code-patch utility. This utility is used to upgrade the controller and EMU software. It can also be used to patch the controller software.

CLI See Command Line Interface.

coax A two-conductor wire in which one conductor completely wraps the other with the two separated by insulation.

cold swap A method of device replacement that requires the entire subsystem to be turned off before the device can be replaced. *See also* hot swap and warm swap.

command line interface CLI. A command line entry utility used to interface with the HS-series controllers. CLI enables the configuration and monitoring of a storage subsystem through textual commands.

concat commands Concat commands implement storageset expansion features.

configuration file A file that contains a representation of a storage subsystem configuration.

container 1) Any entity that is capable of storing data, whether it is a physical device or a group of physical devices. (2) A virtual, internal controller structure representing either a single disk or a group of disk drives linked as a storageset. Stripesets and mirrorsets are examples of storageset containers the controller uses to create units.

controller A hardware device that, with proprietary software, facilitates communications between a host and one or more devices organized in an array. The HSG80 family controllers are examples of array controllers.

copying A state in which data to be copied to the mirrorset is inconsistent with other members of the mirrorset. *See also* normalizing.

copying member Any member that joins the mirrorset after the mirrorset is created is regarded as a copying member. Once all the data from the normal member (or members) is copied to a normalizing or copying member, the copying member then becomes a normal member. *See also* normalizing member.

CSR An acronym for control and status register.

DAEMON Pronounced "demon." A program usually associated with a UNIX systems that performs a utility (housekeeping or maintenance) function without being requested or even known of by the user. A daemon is a diagnostic and execution monitor.

data center cabinet A generic reference to large subsystem cabinets, such as the cabinets in which HP StorageWorks components can be mounted.

data striping The process of segmenting logically sequential data, such as a single file, so that segments can be written to multiple physical devices (usually disk drives) in a round-robin fashion. This technique is useful if the processor is capable of reading or writing data faster than a single disk can supply or accept the data. While data is being transferred from the first disk, the second disk can locate the next segment.

DDL Dual data link. The ability to operate on the CI bus using both paths simultaneously to the same remote node.

device *See* node and peripheral device.

differential I/O module A 16-bit I/O module with SCSI bus converter circuitry for extending a differential SCSI bus. *See also* I/O module.

differential SCSI bus A bus in which a signal level is determined by the potential difference between two wires. A differential bus is more robust and less subject to electrical noise than is a single-ended bus.

DIMM Dual inline Memory Module.

dirty data The write-back cached data that has not been written to storage media, even though the host operation processing the data has completed.

DMA Direct Memory Access.

DOC DWZZA-On-a-Chip. ASCSI bus extender chip used to connect a SCSI bus in an expansion cabinet to the corresponding SCSI bus in another cabinet (See DWZZA).

driver A hardware device or a program that controls or regulates another device. For example, a device driver is a driver developed for a specific device that allows a computer to operate with the device, such as a printer or a disk drive.

dual-redundant configuration A controller configuration consisting of two active controllers operating as a single controller. If one controller fails, the other controller assumes control of the failing controller devices.

dual-simplex A communications protocol that allows simultaneous transmission in both directions in a link, usually with no flow control.

DUART Dual universal asynchronous receiver and transmitter. An integrated circuit containing two serial, asynchronous transceiver circuits.

DWZZA An HP StorageWorks SCSI bus signal converter used to connect 8-bit single-ended devices to hosts with 16-bit differential SCSI adapters. This converter extends the range of a single-ended SCSI cable to the limit of a differential SCSI cable.

DWZZB An HP StorageWorks SCSI bus signal converter used to connect a variety of 16-bit single-ended devices to hosts with 16-bit differential SCSI adapters.

ECB External cache battery. The unit that supplies backup power to the cache module in the event the primary power source fails or is interrupted.

ECC Error checking and correction.

EDC Error detection code.

EIA The abbreviation for Electronic Industries Association. EIA is a standards organization specializing in the electrical and functional characteristics of interface equipment.

EMU Environmental monitoring unit. A unit that provides increased protection against catastrophic failures. Some subsystem enclosures include an EMU which works with the controller to detect conditions such as failed power supplies, failed blowers, elevated temperatures, and external air sense faults. The EMU also controls certain cabinet hardware including DOC chips, alarms, and fan speeds.

ESD	Electrostatic discharge. The discharge of potentially harmful static electrical voltage as a result of improper grounding.
extended subsystem	A subsystem in which two cabinets are connected to the primary cabinet.
external cache battery	*See* ECB.
F_Port	A port in a fabric where an N_Port or NL_Port may attach.
fabric	A group of interconnections between ports that includes a fabric element.
failback	The process of restoring data access to the newly-restored controller in a dual-redundant controller configuration. See also failover.
failedset	A group of failed mirrorset or RAIDset devices automatically created by the controller.
failover	The process that takes place when one controller in a dual-redundant configuration assumes the workload of a failed companion controller. Failover continues until the failed controller is repaired or replaced. The ability for HSG80 controllers to transfer control from one controller to another in the event of a controller failure. This ensures uninterrupted operation. Use Transparent Failover mode for single HBA configurations. Use multiple-bus failover mode for Secure Path based configurations.
FCA	Fibre Channel Adapter
FC–AL	The Fibre Channel Arbitrated Loop standard. See *Fibre Channel.*
FC–ATM	ATM AAL5 over Fibre Channel
FC–FG	Fibre Channel Fabric Generic Requirements
FG–FP	Fibre Channel Framing Protocol (HIPPI on FC)
FC-GS-1	Fibre Channel Generic Services-1
FC–GS-2	Fibre Channel Generic Services-2
FC–IG	Fibre Channel Implementation Guide
FC–LE	Fibre Channel Link Encapsulation (ISO 8802.2)
FC–PH	The Fibre Channel Physical and Signaling standard.
FC–SB	Fibre Channel Single Byte Command Code Set
FC–SW	Fibre Channel Switched Topology and Switch Controls

FCC Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

FCC Class A This certification label is on electronic devices that can only be used in a commercial environment within the United States.

FCC Class B This certification label is on electronic devices that can be used in either a home or a commercial environment within the United States.

FCP The mapping of SCSI-3 operations to Fibre Channel.

FDDI Fiber Distributed Data Interface. An ANSI standard for 100 megabaud transmission over fiber optic cable.

FD SCSI The fast, narrow, differential SCSI bus with an 8-bit data transfer rate of 10 MB/s. *See also* FWD SCSI and SCSI.

fiber A fiber or optical strand. Spelled ***fibre*** in Fibre Channel.

fiber optic cable A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is noted for its properties of electrical isolation and resistance to electrostatic contamination.

Fibre Channel A high speed, high-bandwidth serial protocol for channels and networks that interconnect over twisted pair wires, coaxial cable or fiber optic cable. The Fibre Channel Switched (FC-SW) (fabric) offers up to 16 million ports with cable lengths of up to 10 kilometers. The Fibre Channel Arbitrated Loop (FC-AL) topology offers speeds of up to 100 Mbytes/seconds and up to 127 nodes, all connected in serial. In contrast to SCSI technology, Fibre Channel does not require ID switches or terminators. The FC-AL loop may be connected to a Fibre Channel fabric for connection to other nodes.

fibre channel topology An interconnection scheme that allows multiple Fibre Channel ports to communicate with each other. For example, point-to-point, Arbitrated Loop, and switched fabric are all Fibre Channel topologies.

FL_Port A port in a fabric where N_Port or an NL_Port may be connected.

flush The act of writing dirty data from cache to a storage media.

FMU Fault management utility.

forced errors A data bit indicating a corresponding logical data block contains unrecoverable data.

frame An invisible unit used to transfer information in Fibre Channel.

FRU Field replaceable unit. A hardware component that can be replaced at the customer location by service personnel or qualified customer service personnel.

FRUTIL Field Replacement utility.

full duplex (n) A communications system in which there is a capability for 2-way transmission and acceptance between two sites at the same time.

full duplex (adj) Pertaining to a communications method in which data can be transmitted and received at the same time.

FWD SCSI A fast, wide, differential SCSI bus with a maximum 16-bit data transfer rate of 20 MB/s. *See also* SCSI and FD SCSI.

GBIC Gigabit Interface Converter. GBICs convert electrical signals to optical signals (and vice-versa.) They are inserted into the ports of the Fibre Channel switch and hold the Fibre Channel cables.

GLM Gigabit link module

giga A prefix indicating a billion (10^9) units, as in gigabaud or gigabyte.

gigabaud An encoded bit transmission rate of one billion (10^9) bits per second.

gigabyte A value normally associated with a disk drives storage capacity, meaning a billion (10^9) bytes. The decimal value 1024 is usually used for one thousand.

half-duplex (adj) Pertaining to a communications system in which data can be either transmitted or received but only in one direction at one time.

hard address The AL_PA which an NL_Port attempts to acquire during loop initialization.

heterogeneous host support Also called *noncooperating host support*.

HIPPI–FC Fibre Channel over HIPPI

host The primary or controlling computer to which a storage subsystem is attached.

host adapter A device that connects a host system to a SCSI bus. The host adapter usually performs the lowest layers of the SCSI protocol. This function may be logically and physically integrated into the host system.

HBA Host bus adapter

host compatibility mode A setting used by the controller to provide optimal controller performance with specific operating systems. This improves the controller performance and compatibility with the specified operating system.

hot disks A disk containing multiple hot spots. Hot disks occur when the workload is poorly distributed across storage devices which prevents optimum subsystem performance. *See also* hot spots.

hot spots A portion of a disk drive frequently accessed by the host. Because the data being accessed is concentrated in one area, rather than spread across an array of disks providing parallel access, I/O performance is significantly reduced. *See also* hot disks.

hot swap or hot-pluggable A method of device replacement that allows normal I/O activity on a device bus to remain active during device removal and insertion. The device being removed or inserted is the only device that cannot perform operations during this process. *See also* cold swap and warm swap.

hub A device (concentrator) which performs some or all of the following functions:

- Automatic insertion of operational loop devices without disrupting the existing configuration.
- Automatic removal of failed loop devices without impacting the existing configuration.
- Provides a centralized (star) wiring configuration and maintenance point.
- Provides central monitoring and management.

IBR Initial Boot Record.

ILF Illegal function.

INIT Initialize input and output.

initiator A SCSI device that requests an I/O process to be performed by another SCSI device, namely, the SCSI target. The controller is the initiator on the device bus. The host is the initiator on the host bus.

instance code A four-byte value displayed in most text error messages and issued by the controller when a subsystem error occurs. The instance code indicates when during software processing the error was detected.

interface A set of protocols used between components, such as cables, connectors, and signal levels.

I/O Refers to input and output functions.

I/O driver The set of code in the kernel that handles the physical I/O to a device. This is implemented as a fork process. Same as driver.

I/O interface *See* interface.

I/O module A 16-bit SBB shelf device that integrates the SBB shelf with either an 8-bit single ended, 16-bit single-ended, or 16-bit differential SCSI bus (see SBB).

I/O operation The process of requesting a transfer of data from a peripheral device to memory (or visa versa), the actual transfer of the data, and the processing and overlaying activity to make both of those happen.

IPI Intelligent Peripheral Interface. An ANSI standard for controlling peripheral devices by a host computer.

IPI-3 Disk Intelligent Peripheral Interface Level 3 for Disk

IPI-3 Tape Intelligent Peripheral Interface Level 3 for Tape

JBOD Just a bunch of disks. A term used to describe a group of single-device logical units.

kernel The most privileged processor access mode.

LBN Logical Block Number.

L_port A node or fabric port capable of performing arbitrated loop functions and protocols. NL_Ports and FL_Ports are loop-capable ports.

LED Light Emitting Diode.

link A connection between two Fibre Channel ports consisting of a transmit fibre and a receive fibre.

local connection A connection to the subsystem using either its serial maintenance port or the host SCSI bus. A local connection enables you to connect to one subsystem controller within the physical range of the serial or host SCSI cable.

local terminal A terminal plugged into the EIA-423 maintenance port located on the front bezel of the controller. *See also* maintenance terminal.

logical bus A single-ended bus connected to a differential bus by a SCSI bus signal converter.

logical unit — A physical or virtual device addressable through a target ID number. LUNs use their target bus connection to communicate on the SCSI bus.

logical unit number — LUN. A value that identifies a specific logical unit belonging to a SCSI target ID number. A number associated with a physical device unit during a task I/O operations. Each task in the system must establish its own correspondence between logical unit numbers and physical devices.

logon — Also called login. A procedure whereby a participant, either a person or network connection, is identified as being an authorized network participant.

loop — *See* arbitrated loop.

loop_ID — A seven-bit value numbered contiguously from zero to 126-decimal and represent the 127 legal AL_PA values on a loop (not all of the 256 hex values are allowed as AL_PA values per FC-AL.)

loop tenancy — The period of time between the following events: when a port wins loop arbitration and when the port returns to a monitoring state.

L_Port — A node or fabric port capable of performing Arbitrated Loop functions and protocols. NL_Ports and FL_Ports are loop-capable ports.

LUN — See logical unit number.

LRU — Least recently used. A cache term used to describe the block replacement policy for read cache.

Mbps — Approximately one million (10^6) bits per second—that is, megabits per second.

maintenance terminal — An EIA-423-compatible terminal used with the controller. This terminal is used to identify the controller, enable host paths, enter configuration information, and check the controller status. The maintenance terminal is not required for normal operations.
See also local terminal.

member — A container that is a storage element in a RAID array.

metadata — The data written to a disk for the purposes of controller administration. Metadata improves error detection and media defect management for the disk drive. It is also used to support storageset configuration and partitioning. Nontransportable disks also contain metadata to indicate they are uniquely configured for HP StorageWorks environments. Metadata can be thought of as “data about data.”

mirroring — The act of creating an exact copy or image of data.

mirrored write-back caching	A method of caching data that maintains two copies of the cached data. The copy is available if either cache module fails.
mirrorset	*See* RAID level 1.
MIST	Module Integrity Self-Test.
multibus failover	Allows the host to control the failover process by moving the units from one controller to another.
N_port	A port attached to a node for use with point-to-point topology or fabric topology.
NL_port	A port attached to a node for use in all topologies.
network	In data communication, a configuration in which two or more terminals or devices are connected to enable information transfer.
node	In data communications, the point at which one or more functional units connect transmission lines.
Non-L_Port	A Node of Fabric port that is not capable of performing the Arbitrated Loop functions and protocols. N_Ports and F_Ports loop-capable ports.
non-participating mode	A mode within an L_Port that inhibits the port from participating in loop activities. L_Ports in this mode continue to retransmit received transmission words but are not permitted to arbitrate or originate frames. An L_Port in non-participating mode may or may not have an AL_PA. *See also* participating mode.
nominal membership	The desired number of mirrorset members when the mirrorset is fully populated with active devices. If a member is removed from a mirrorset, the actual number of members may fall below the “nominal” membership.
node	In data communications, the point at which one or more functional units connect transmission lines. In Fibre Channel, a device that has at least one N_Port or NL_Port.
nonredundant controller configuration	(1) A single controller configuration. (2) A controller configuration that does not include a second controller.
normal member	A mirrorset member that, block-for-block, contains the same data as other normal members within the mirrorset. Read requests from the host are always satisfied by normal members.

normalizing Normalizing is a state in which, block-for-block, data written by the host to a mirrorset member is consistent with the data on other normal and normalizing members. The normalizing state exists only after a mirrorset is initialized. Therefore, no customer data is on the mirrorset.

normalizing member A mirrorset member whose contents are the same as all other normal and normalizing members for data that has been written since the mirrorset was created or lost cache data was cleared. A normalizing member is created by a normal member when either all of the normal members fail or all of the normal members are removed from the mirrorset. *See also* copying member.

NVM Non-Volatile Memory. A type of memory where the contents survive power loss. Also sometimes referred to as NVMEM.

OCP Operator control panel. The control or indicator panel associated with a device. The OCP is usually mounted on the device and is accessible to the operator.

offset A relative address referenced from the base element address. Event Sense Data Response Templates use offsets to identify various information contained within one byte of memory (bits 0 through 7).

other controller The controller in a dual-redundant pair that is connected to the controller serving the current CLI session. *See also* this controller.

outbound fiber One fiber in a link that carries information away from a port.

parallel data transmission A data communication technique in which more than one code element (for example, bit) of each byte is sent or received simultaneously.

parity A method of checking if binary numbers or characters are correct by counting the ONE bits. In odd parity, the total number of ONE bits must be odd; in even parity, the total number of ONE bits must be even.

parity bit A binary digit added to a group of bits that checks to see if errors exist in the transmission.

parity check A method of detecting errors when data is sent over a communications line. With even parity, the number of ones in a set of binary data should be even. With odd parity, the number of ones should be odd.

parity RAID *See* RAIDset.

participating mode A mode within an L_Port that allows the port to participate in loop activities. A port must have a valid AL_PA to be in participating mode.

partition A logical division of a container, represented to the host as a logical unit.

PCMCIA Personal Computer Memory Card Industry Association. An international association formed to promote a common standard for PC card-based peripherals to be plugged into notebook computers. The card commonly known as a PCMCIA card is about the size of a credit card.

PDU Power distribution unit. The power entry device for HP StorageWorks cabinets. The CDU provides the connections necessary to distribute power to the cabinet shelves and fans.

peripheral device Any unit, distinct from the CPU and physical memory, that can provide the system with input or accept any output from it. Terminals, printers, tape drives, and disks are peripheral devices.

pluggable A replacement method that allows the complete system to remain online during device removal or insertion. The system bus must be halted, or quiesced, for a brief period of time during the replacement procedure. See also hot-pluggable.

point-to-point connection A network configuration in which a connection is established between two, and only two, terminal installations. The connection may include switching facilities.

port (1) In general terms, a logical channel in a communications system. (2) The hardware and software used to connect a host controller to a communications bus, such as a SCSI bus or serial bus.

Regarding the controller, the port is (1) the logical route for data in and out of a controller that can contain one or more channels, all of which contain the same type of data. (2) The hardware and software that connects a controller to a SCSI device.

port_name A 64-bit unique identifier assigned to each Fibre Channel port. The Port_Name is communicated during the login and port discovery process.

preferred address The AL_PA which an NL_Port attempts to acquire first during initialization.

primary cabinet The primary cabinet is the subsystem enclosure that contains the controllers, cache modules, external cache batteries, and the PVA module.

private NL_Port An NL_Port which does not attempt login with the fabric and only communicates with NL_Ports on the same loop.

program card The PCMCIA card containing the controller operating software.

protocol The conventions or rules for the format and timing of messages sent and received.

PTL Port-Target-LUN. The controller method of locating a device on the controller device bus.

PVA module Power Verification and Addressing module.

quiesce The act of rendering bus activity inactive or dormant. For example, "quiesce the SCSI bus operations during a device warm-swap."

RAID Redundant Array of Independent Disks. Represents multiple levels of storage access developed to improve performance or availability or both.

RAID level 0 A RAID storageset that stripes data across an array of disk drives. A single logical disk spans multiple physical disks, enabling parallel data processing for increased I/O performance. While the performance characteristics of RAID level 0 is excellent, this RAID level is the only one that does not provide redundancy. Raid level 0 storagesets are sometimes referred to as stripesets.

RAID level 0+1 A RAID storageset that stripes data across an array of disks (RAID level 0) and mirrors the striped data (RAID level 1) to provide high I/O performance and high availability. This RAID level is alternatively called a striped mirrorset.

RAID level 1 A RAID storageset of two or more physical disks that maintain a complete and independent copy of the entire virtual disk's data. This type of storageset has the advantage of being highly reliable and extremely tolerant of device failure. Raid level 1 storagesets are sometimes referred to as mirrorsets.

RAID level 3 A RAID storageset that transfers data parallel across the array disk drives a byte at a time, causing individual blocks of data to be spread over several disks serving as one enormous virtual disk. A separate redundant check disk for the entire array stores parity on a dedicated disk drive within the storageset. *See also* RAID level 5.

RAID level 5 A RAID storageset that, unlike RAID level 3, stores the parity information across all of the disk drives within the storageset. *See also* RAID level 3.

RAID level 3/5 A RAID storageset that stripes data and parity across three or more members in a disk array. A RAIDset combines the best characteristics of RAID level 3 and RAID level 5. A RAIDset is the best choice for most applications with small to medium I/O requests, unless the application is write intensive. A RAIDset is sometimes called parity RAID.

RAIDset *See* RAID level 3/5.

RAM Random access memory.

read ahead caching A caching technique for improving performance of synchronous sequential reads by prefetching data from disk.

read caching A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives.

reconstruction The process of regenerating the contents of a failed member data. The reconstruct process writes the data to a spareset disk and incorporates the spareset disk into the mirrorset, striped mirrorset, or RAIDset from which the failed member came. *See also* regeneration.

reduced Indicates that a mirrorset or RAIDset is missing one member because the member has failed or has been physically removed.

redundancy The provision of multiple interchangeable components to perform a single function in order to cope with failures and errors. A RAIDset is considered to be redundant when user data is recorded directly to one member and all of the other members include associated parity information.

regeneration (1) The process of calculating missing data from redundant data. (2) The process of recreating a portion of the data from a failing or failed drive using the data and parity information from the other members within the storageset. The regeneration of an entire RAIDset member is called reconstruction. *See also* reconstruction.

remote copy A feature intended for disaster tolerance and replication of data from one storage subsystem or physical site to another subsystem or site. Remote copy also provides methods of performing a backup at either the local or remote site. With remote copy, user applications continue to run while data movement goes on in the background. Data warehousing, continuous computing, and enterprise applications all require remote copy capabilities.

remote copy set A bound set of two units, one located locally and one located remotely, for long-distance mirroring. The units can be a single disk, or a storageset, mirrorset, or RAIDset. A unit on the local controller is designated as the “initiator” and a corresponding unit on the remote controller is designated as the “target”.

request rate The rate at which requests are arriving at a servicing entity.

RFI Radio frequency interference. The disturbance of a signal by an unwanted radio signal or frequency.

replacement policy The policy specified by a switch with the SET FAILEDSET command indicating whether a failed disk from a mirrorset or RAIDset is to be automatically replaced with a disk from the spareset. The two switch choices are AUTOSPARE and NOAUTOSPARE.

SBB HP StorageWorks building block. (1) A modular carrier plus the interface required to mount the carrier into a standard HP StorageWorks shelf. (2) any device conforming to shelf mechanical and electrical standards installed in a 3.5-inch or 5.25-inch carrier, whether it is a storage device or power supply.

SCSI Small computer system interface. (1) An ANSI interface standard defining the physical and electrical parameters of a parallel I/O bus used to connect initiators to devices. (2) a processor-independent standard protocol for system-level interfacing between a computer and intelligent devices including hard drives, floppy disks, CD-ROMs, printers, scanners, and others.

SCSI-A cable A 50-conductor (25 twisted-pair) cable generally used for single-ended, SCSI-bus connections.

SCSI bus signal converter Sometimes referred to as an adapter. (1) A device used to interface between the subsystem and a peripheral device unable to be mounted directly into the SBB shelf of the subsystem. (2) a device used to connect a differential SCSI bus to a single-ended SCSI bus. (3) A device used to extend the length of a differential or single-ended SCSI bus. *See also* DOC (DWZZA-On-a-chip) and I/O module.

SCSI device (1) A host computer adapter, a peripheral controller, or an intelligent peripheral that can be attached to the SCSI bus. (2) Any physical unit that can communicate on a SCSI bus.

SCSI device ID number A bit-significant representation of the SCSI address referring to one of the signal lines, numbered 0 through 7 for an 8-bit bus, or 0 through 15 for a 16-bit bus. *See also* target ID number.

SCSI ID number	The representation of the SCSI address that refers to one of the signal lines numbered 0 through 15.
SCSI-P cable	A 68-conductor (34 twisted-pair) cable generally used for differential bus connections.
SCSI port	(1) Software: The channel controlling communications to and from a specific SCSI bus in the system. (2) Hardware: The name of the logical socket at the back of the system unit to which a SCSI device is connected.
serial transmission	A method transmission in which each bit of information is sent sequentially on a single channel rather than simultaneously as in parallel transmission.
signal converter	*See* SCSI bus signal converter.
single ended I/O module	A 16-bit I/O module. *See also* I/O module.
single-ended SCSI bus	An electrical connection where one wire carries the signal and another wire or shield is connected to electrical ground. Each signal logic level is determined by the voltage of a single wire in relation to ground. This is in contrast to a differential connection where the second wire carries an inverted signal.
spareset	A collection of disk drives made ready by the controller to replace failed members of a storageset.
storage array	An integrated set of storage devices.
storage array subsystem	*See* storage subsystem.
storageset	(1) A group of devices configured with RAID techniques to operate as a single container. (2) Any collection of containers, such as stripesets, mirrorsets, striped mirrorsets, and RAIDsets.
storageset expansion	The dynamic expansion of the storage capacity (size) of a unit. A storage container is created in the form of a concatenation set which is added to the existing storage set defined as a unit.
storage subsystem	The controllers, storage devices, shelves, cables, and power supplies used to form a mass storage subsystem.
storage unit	The general term that refers to storagesets, single-disk units, and all other storage devices that are installed in your subsystem and accessed by the host. A storage unit can be any entity that is capable of storing data, whether it is a physical device or a group of physical devices.

StorageWorks A family of modular data storage products that allow customers to design and configure their own storage subsystems. Components include power, packaging, cabling, devices, controllers, and software. Customers can integrate devices and array controllers in HP StorageWorks enclosures to form storage subsystems.

HP StorageWorks systems include integrated SBBs and array controllers to form storage subsystems. System-level enclosures to house the shelves and standard mounting devices for SBBs are also included.

stripe The data divided into blocks and written across two or more member disks in an array.

striped mirrorset *See* RAID level 0+1.

stripeset *See* RAID level 0.

stripe size The stripe capacity as determined by *n*–1 times the chunksize, where *n* is the number of RAIDset members.

striping The technique used to divide data into segments, also called chunks. The segments are striped, or distributed, across members of the stripeset. This technique helps to distribute hot spots across the array of physical devices to prevent hot spots and hot disks.

Each stripeset member receives an equal share of the I/O request load, improving performance.

surviving controller The controller in a dual-redundant configuration pair that serves its companion devices when the companion controller fails.

switch A method that controls the flow of functions and operations in software.

synchronous Pertaining to a method of data transmission which allows each event to operate in relation to a timing signal. *See also* asynchronous.

tape A storage device supporting sequential access to variable sized data records.

target (1) A SCSI device that performs an operation requested by an initiator. (2) Designates the target identification (ID) number of the device.

target ID number The address a bus initiator uses to connect with a bus target. Each bus target is assigned a unique target address.

this controller The controller that is serving your current CLI session through a local or remote terminal. *See also* other controller.

tape inline exerciser	(TILX) The controller diagnostic software to test the data transfer capabilities of tape drives in a way that simulates a high level of user activity.
topology	An interconnection scheme that allows multiple Fibre Channel ports to communicate with each other. For example, point-to-point, Arbitrated Loop, and switched fabric are all Fibre Channel topologies.
transfer data rate	The speed at which data may be exchanged with the central processor, expressed in thousands of bytes per second (kbytes).
transparent failover	Keeps the storage array available to the hosts by allowing the surviving controller of a dual redundant pair to take over total control of the subsystem and is transparent (invisible) to the hosts.
ULP **ULP process**	Upper Layer Protocol. A function executing within a Fibre Channel node which conforms to the Upper Layer Protocol (ULP) requirements when interacting with other ULP processes.
Ultra SCSI	A Fast-20 SCSI bus. *See also* Wide Ultra SCSI.
unit	A container made accessible to a host. A unit may be created from a single disk drive or tape drive. A unit may also be created from a more complex container such as a RAIDset. The controller supports a maximum of eight units on each target. *See also* target and target ID number.
unwritten cached data	Sometimes called unflushed data. *See* dirty data.
UPS	Uninterruptible power supply. A battery-powered power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.
VHDCI	Very high-density-cable interface. A 68-pin interface. Required for Ultra-SCSI connections.
virtual terminal	A software path from an operator terminal on the host to the controller's CLI interface, sometimes called a host console. The path can be established via the host port on the controller or via the maintenance port through an intermediary host.
VTDPY	An abbreviation for Virtual Terminal Display Utility.

warm swap A device replacement method that allows the complete system to remain online during device removal or insertion. The system bus may be halted, or quiesced, for a brief period of time during the warm-swap procedure.

Wide Ultra SCSI Fast/20 on a Wide SCSI bus.

Worldwide name A unique 64-bit number assigned to a subsystem by the Institute of Electrical and Electronics Engineers (IEEE) and set by manufacturing prior to shipping. This name is referred to as the node ID within the CLI.

write-back caching A cache management method used to decrease the subsystem response time to write requests by allowing the controller to declare the write operation "complete" as soon as the data reaches its cache memory. The controller performs the slower operation of writing the data to the disk drives at a later time.

write-through caching Write-through caching always writes directly to disk, ensuring that the application is never tricked into believing that the data is on the disk when it may not be. This results in highest data integrity, though with slightly reduced performance.

write hole The period of time in a RAID level 1 or RAID level 5 write operation when an opportunity emerges for undetectable RAIDset data corruption. Write holes occur under conditions such as power outages, where the writing of multiple members can be abruptly interrupted. A battery backed-up cache design eliminates the write hole because data is preserved in cache and unsuccessful write operations can be retried.

write-through cache A cache management technique for retaining host write requests in read cache. When the host requests a write operation, the controller writes data directly to the storage device. This technique allows the controller to complete some read requests from the cache, greatly improving the response time to retrieve data. The operation is complete only after the data to be written is received by the target storage device.

This cache management method may update, invalidate, or delete data from the cache memory accordingly, to ensure that the cache contains the most current data.

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